Poet® Plus 8100
Patient Monitor
Service Manual

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Criticare Systems, Inc., is not responsible for the effects on safety, reliability and performance of the 8100 Patient Monitor if: assembly operations, extensions, readjustments, modifications or repairs are carried out by persons other than those authorized by Criticare Systems, Inc., or

the 8100 Patient Monitor is not used in accordance with the instructions for use, or

the electrical installation of the relevant room does not comply with NFPA 70: National Electric Code or NFPA 99: Standard for Health Care Facilities (Outside the United States, the relevant room must comply with all electrical installation regulations mandated by the local and regional bodies of government).

In Case of Emergency Contact

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Orders: (800) 458-4615
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Service Return Policy

Return Procedure

In the event that it becomes necessary to return a unit to Criticare Systems, Inc., the following procedure should be followed:

Obtain return authorization. Contact the CSI Service Department at 800-458-2697 to obtain a Customer Service Authorization (CSA) number. (Outside the US, call 001-262-798-8282.) The CSA number must appear on the outside of the shipping container. Return shipments will not be accepted if the CSA number is not clearly visible. Please provide the model number, serial number, and a brief description of the reason for return.

Freight policy. The customer is responsible for freight charges when equipment is shipped to CSI for service (this includes customs charges).

Loaner service. In the U.S. If it is necessary to provide a loaner system, CSI will ship a loaner by overnight courier. The loaner system must be returned to CSI at the customer's expense within one week after receipt of the repaired goods. If the unit is not returned to CSI within that time, the customer will be invoiced for the full purchase price of the equipment.

Outside the U.S. No loaners are available from CSI internationally. Contact your local CSI representative.

EC Declaration of Conformity

Poet® Plus 8100 Patient Monitor

To view the Declaration of Conformity, visit the Criticare website at www.csiusa.com. A copy of the Declaration can also be faxed. Contact Criticare's customer service department at (262) 798-8282 to obtain a faxed copy of the Declaration.

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Section 1 —Introduction

Description

The Poet® Plus 8100 patient monitor interprets and displays real time physiological data including waveforms and numerical data. The monitor is designed for multi-parameter measurements, including ECG, NIBP, SpO_2, temperature, and respiration with optional IBP, CO_2, and O_2. For all these vital parameters the Poet Plus 8100 patient monitor has limit alarms and alerts. The monitor also prints strip chart recordings and stores tabular trends for review.

Intended Use

The Poet Plus 8100 patient monitor monitors physiological parameters of patients within clinical care settings. It is intended that the user is a professional health care provider. Physiological data, system alarms, and patient data analysis are available to the care provider from the monitor.

The user is responsible for the interpretation of the monitored data that is made available. Physiological data should be reviewed by a qualified clinical personnel prior to any medical intervention.

Poet Plus 8100 Patient Monitor Options

The Poet Plus 8100 patient monitor comes standard with 5-Lead ECG, ComfortCuff™ NIBP, DOX™ SpO_2, and two temperature channels for monitoring. Optional features include two IBP channels, an internal printer, and CO_2 and O_2 monitoring. A color TFT screen with a six waveform display is standard on all Poet Plus 8100 patient monitors.

Catalog Number	Printer	Additional Features	External Module Port
CAT81C000X00ECX	No	Standard	Yes
CAT81C001X00ECX	No	CO_2	Yes
CAT81C005X00ECX	No	CO_2, O_2	Yes
CAT81C024X00ECX	No	IBP	Yes
CAT81C025X00ECX	No	IBP/CO_2	Yes
CAT81C028X00ECX	No	IBP/CO_2/O_2	Yes
CAT81C000P00ECX	Yes	Standard	Yes
CAT81C001P00ECX	Yes	CO_2	Yes
CAT81C005P00ECX	Yes	CO_2, O_2	Yes
CAT81C024P00ECX	Yes	IBP	Yes
CAT81C025P00ECX	Yes	IBP/CO_2	Yes
CAT81C028P00ECX	Yes	IBP/CO_2/O_2	Yes

The units (shown above) are listed as “E” in the Cat. No. and have an English language label set and instructions. Contact customer service for additional language options.

The instructions in this manual cover the operation of each of the option packages listed above. For those models that do not include a particular monitoring module (i.e. CO_2 or O_2) the monitor functions as if that module had been turned off in the monitor. Some Poet Plus 8100 patient monitors may not have an external module connection and may require updates to meet the specifications described in this manual.

Pulse Oximetry Measurement (SpO_2)

The patient monitor uses Digital Oximetry (DOX™) technology to measure blood oxygen saturation (SpO_2).

Definition

Hemoglobin exists in the blood in several forms:

- Oxygenated (Oxyhemoglobin)
- Reduced (Deoxyhemoglobin)
- Dyshemoglobins (carboxyhemoglobin and methemoglobin.)

In the patient monitor, SpO_2 (pulse arterial oxygen saturation) is the ratio of oxygenated hemoglobin to the sum of oxygenated hemoglobin plus hemoglobin which is available for binding to oxygen, as expressed in the following formula:

$$\text{percent oxygen saturation} = \frac{\text{oxyhemoglobin}}{\text{oxyhemoglobin} + \text{deoxyhemoglobin}} \times 100$$

Dyshemoglobins, such as carboxyhemoglobin and methemoglobin, are not directly measured and therefore are not factored into the measurement.

DOX™ Digital Oximetry

The patient monitor does not use analog circuitry for signal processing. Digital signal processing in the microprocessor results in lower noise from circuitry components, resulting in a cleaner signal and better performance under low perfusion conditions. There is also improved rejection of noise from the patient and environment, due to the availability of the “true,” unfiltered sensor signal for digital signal processing.

Method

The digital pulse oximeter measures oxygen saturation and pulse rate using the principles of spectrophotometry and plethysmography. The sensor is completely non-invasive, and there is no heat source that could burn the patient.

The pulse oximeter sensor contains two types of LEDs. Each type emits a specific wavelength of light. Since oxygenated hemoglobin and deoxygenated hemoglobin absorb light selectively and predictably, we can determine the amounts of these two compounds by measuring the intensity of each wavelength that passes through the measuring site.

The light from the LEDs shines into a pulsating vascular bed. A photodetector located opposite or alongside the LEDs measures the intensity of each wavelength transmitted through the monitoring site. The light intensity is converted to an electrical signal, which is input to the monitor. The effects of skin pigmentation, venous blood, and other tissue constituents are eliminated by separating out the pulsating absorption data.

SpO_2 Clinical Testing and Accuracy

All Criticare oximeters (DOX™ compatible) have SpO_2 calibration tables which were originally generated by monitoring desaturated human patients or volunteers and matching their displayed SpO_2 value to the value determined by sampling arterial blood and measuring functional SaO_2 with a clinical laboratory grade multi-wavelength optical oximeter (i.e. CO-oximeter). The final SpO_2 calibration curve was then generated based upon numerous patients' data over the range of 40 to 99% SaO_2. All accepted data were taken from patients with dyshemoglobin (i.e., carboxyhemoglobin, methemoglobin) concentrations near zero.

This oximeter is a two-wavelength device, which is calibrated to measure functional SpO_2 only when dyshemoglobin concentrations are near zero. The accuracy specifications of this device will not be met with high concentrations of dyshemoglobins. Significant concentrations of carboxyhemoglobin results in a higher displayed SpO_2 value than is actually present in the patient.

Heart Rate

The heart rate is determined primarily from the ECG waveform data. A beat detection algorithm is used to identify QRS beats.

The patient monitor has a user selectable smart heart rate function. It automatically uses alternate sources to determine heart rate if the primary source becomes unmeasurable:

- The IBP waveform is used if the ECG waveform data is unavailable.
- The plethysmograph (SpO_2 waveform) is used if the IBP waveform data or ECG heart rate is unavailable.
- In the absence of SpO_2, IBP, and ECG data, the NIBP oscillometric data is the final default source for a heart rate measurement.

Response times for ECG heart rate meter change from 80 BPM to 40 BPM and from 80 BPM to 120 BPM is less than or equal to 10 seconds. The alarm for tachycardia is less than or equal to 10 seconds per EC 13.

NOTE: The accuracy of the heart rate depends upon the source. The range of the measurable NIBP based heart rate does not extend as far as the range available in other modules used by the smart heart rate feature.

NOTE: The NIBP based heart rate is not a continuous measurement and is only current during an NIBP measurement.

ECG Measurement

The electrocardiogram (ECG or EKG) records the changing potential generated by electrical activity of the heart.

Method

To obtain an overall view of the heart's electrical activity, three or five electrodes attached to lead wires detect electrical impulses from the patient's heart to the skin. The patient monitor calculates the difference in electrical force between two electrode sites. Electrode polarity (positive, negative, or ground) depends on the cable receptacle the lead wire is attached to and the lead selected on the patient monitor screen.

The ECG design uses the standard (conventional bi-polar limb leads) leads I, II, III and uses a 3-lead or 5-lead cable accessory. With the 5-lead cable accessory, you may also view leads aVR, aVL, aVF, and V lead.

The monitor has user-selectable automatic lead switching capability when using the 5-lead settings. If a lead becomes detached or is unmeasurable, the monitor can automatically display an alternate lead view using the remaining leads.

Stability of Accuracy

The patient monitor is equipped with pacemaker detection and user-selectable pacer rejection. There are no known safety hazards due to the operation of a cardiac pacemaker or other electrical stimulators when used with this patient monitor.

The accuracy of the patient monitor is not affected by arrhythmia or other physiological conditions where the electrocardiogram amplitude and heart rate are within the detectable limits specified for the monitor. The patient monitor has user-selectable signal filtering in the 60 Hz and 50 Hz bands that reduce electrical interference from the AC (mains) power sources. User-selectable filters are also available.

The accuracy of the ECG analog output bandwidth is equal to the frequency response specified in the ECG specifications. The variable gain control is x200, x400, or x800 (according to the ECG Sensitivity setting). The propagation delay is 1000 milliseconds.

The accuracy of the synchronizing pulse amplitude is equal to 500 times that of leadview II. The pulse shape and duration match those of leadview II. The output impedance is 1000 ohms and propagation delay is less than 6.6 milliseconds.

Pacemaker Pulse Rejection

With the pacemaker detector turned *ON* in the 8100, the system detects and rejects pacemaker pulses ranging from ±2 to ±700 mV amplitude and 0.1 to 2.0 ms duration. Heart rates properly display over this range of pacemaker operation. Pacer pulse markers are present if pace detect is on and appear in the ECG analog output as narrow positive spikes at the point of pace detection.

⚠CAUTION⚠

- Ambient noise sources may induce artifactual triggers of the pacemaker pulse detector and display.

Respiration

Respiration is measured via the ECG electrodes or by using the respiration cycle data from the optional CO_2 monitoring module.

To determine respiration from the ECG, the patient monitor measures patient respiration by impedance pneumography. As the patient's chest changes size and shape during inspiration and expiration, the resistance between two chest (or abdomen) ECG electrodes changes. Respiration rate is calculated from this change in resistance.

The user may select the ECG which uses the impedance measurement based off of lead I or the CO_2 respiration that is based of the capnogram. There is also a selectable smart respiration function that can automatically switch sources, if there is an interruption of waveform data. The CO_2 data is the primary source for the smart respiration function and it defaults to the CO_2 source if it is available.

Non-Invasive Blood Pressure (NIBP)

The patient monitor uses ComfortCuff™ technology to determine non-invasive blood pressure by means of oscillometry. The oscillometric method detects volume displacements within the artery and senses pressure variations within the blood pressure cuff during inflation. The patient monitor uses cuffs ranging in size from neonate cuffs to thigh cuffs.

Comfort Cuff™ Technology

ComfortCuff™ technology measures NIBP while the cuff inflates. Consequently, a measurement is obtained more quickly and with less discomfort than with monitors, which measure NIBP during cuff deflation.

Description of NIBP Measurement

The NIBP cuff begins to inflate at the beginning of the NIBP measurement cycle. As the cuff pressure approaches the diastolic pressure of the patient, the cuff pressure waveform begins to indicate the pulse waveform. The cuff pressure at this point is equal to the patient's diastolic pressure, which is stored by the patient monitor.

As cuff pressure continues to increase, the pulse waveform (as measured from BP cuff pressure fluctuation) becomes stronger, reaching its maximum at the patient’s mean arterial pressure (i.e., when cuff pressure = mean BP). The monitor stores this value as mean pressure.

As cuff pressure increases further, it approaches the patient’s systolic pressure, and the cuffs pulse waveform decreases in amplitude. The cuff pulse waveform disappears at the point where cuff pressure is equal to the patient’s systolic pressure.

When the patient monitor determines that the cuff waveform has decreased to zero amplitude, it stores the cuff pressure value as the systolic pressure, and releases the pressure from the cuff. This typically occurs at about 10 mmHg over the patient's systolic pressure. The cuff then rapidly deflates.

NIBP Clinical Testing and Accuracy

This device was clinically tested per the requirements of EN 1060 and AAMI SP-10. The NIBP module as installed in the Poet Plus 8100 patient monitor is tested to meet the performance specifications listed in this manual.

Cuff Inflation and Pressure Protection

The maximum cuff inflation rate is 15 mmHg/sec. The software limits inflation to 300 mmHg adult, 300 mmHg pediatric, or 150 neonate. A secondary circuit limits maximum possible cuff pressure to 332 mmHg in adult/pediatric mode and 166 mmHg in neonatal mode. Cuff pressure is allowed to remain above 30 mmHg for a maximum of 2 minutes.

The patient monitor automatically deflates the cuff if the time limit is violated. The patient monitor contains hardware protection for overpressure conditions, pressure transducer failures, or microprocessor and pump control circuit failures.

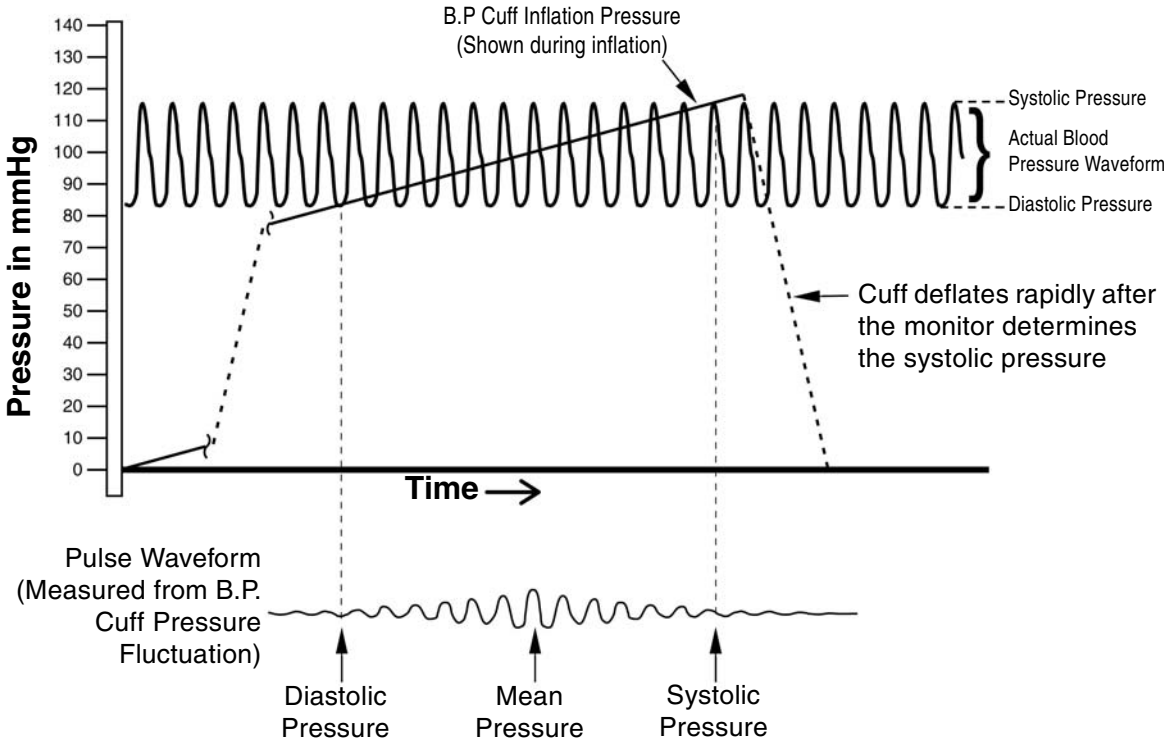


Figure 1-1: NIBP Cuff Pressure and Pulse over Time

Invasive Blood Pressure (IBP)

The IBP monitoring module is intended for direct pressure monitoring using an intra-arterial catheter, a continuous flushing system, and an IBP transducer. The IBP module provides analog to digital conversion of the transducer signal.

The IBP module processes continuous digital patient data that can be displayed as waveform and numerical values. The module supports up to two separate IBP channels simultaneously. For arterial and pulmonary artery IBP measurements the numerical values for systolic, diastolic, and mean pressure are computed and displayed.

Method of Measurement

The IBP module uses standard invasive pressure monitoring techniques. A bridge transducer is measured by a highly accurate analog to digital converter. The measuring circuit uses a 5 volt excitation voltage that provides a transfer function of 25 micro-volts per mmHg of pressure.

The signal is buffered and brought to the A/D converter, which is configured for a full scale signal of ±25 millivolts. The circuit has a potential measuring range of ±1000 mmHg of pressure. This range is restricted to -20 to +300 mmHg for actual monitoring purposes. There is no analog amplification of the transducer signal.

The module uses a rate of 50 samples per second for each of the two independent IBP channels. The resulting measurement resolution is slightly less than 0.5 mmHg. The numerical IBP value is reported by the Poet Plus 8100 monitor at a resolution of 1 mmHg.

Non-pulsatile IBP sites, LA, RA, CVP or ICP, are reported as mean numerical values. The non-pulsatile mean value is an average of the last 200 samples taken over a period of approximately 4 seconds. The values for pulsatile sites, ART and PA, are reported as an average of the last 8 calculated values.

The IBP heart rate is reported as an average of the last 16 heart rate values. The software also scans for sudden changes in heart rate and overrides the averaging function when the condition occurs.

IBP Clinical Testing and Accuracy

The invasive blood pressure module is in compliance with applied standard IEC 601-2-34 and has been tested to meet the performance specifications listed in this manual. The module as installed in the Poet Plus 8100 patient monitor has been clinically tested for performance with a variety of patients.

Capnometry (Measurement of CO_2)

The Poet Plus 8100 patient monitor uses the sidestream method of measuring CO_2. Gas is aspirated through a nasal cannula or a ventilation circuit adapter. The gas sample enters from a sampling tube into a water trap, which removes water vapor and particulate matter from the gas sample. The gas then enters the CO_2 detector where it is analyzed.

The patient monitor measures CO_2 concentrations and displays them in a continuous waveform. The patient monitor also detects end-tidal and fraction Inspired CO_2 levels, displaying them numerically. End-tidal CO_2 ($ETCO_2$) is defined as the maximum CO_2 concentration at the end of expiration. The patient monitor measures and displays this numerical value of CO_2 concentration. The $ETCO_2$ value is updated continuously with each breath cycle. The amount of CO_2 in the gas mixture inhaled in by the patient is the fractional Inspired CO_2 ($FICO_2$).

Method of Measurement

The patient monitor measures CO_2 using the principles of infrared absorption spectrometry. An unknown concentration of gas (CO_2) is calculated by comparing its absorption of infrared light to that of a known standard. The absorption of light is directly related to the concentration of the gas. As infrared light passes through the sample gas chamber, the light transmitted is converted to a voltage signal. The patient monitor converts the voltage to CO_2 concentration and expresses it as mmHg, percent (%), or kPa (user selectable).

Infrared analysis of the gas samples is done using Beer's Law.

The formula for Beer's Law:

$$I = I_0 e^{-\varepsilon(\lambda)cd}$$

- I Infrared value of measured sample.
- I_0 Infrared value of light source.
- e Exponential function.
- $\varepsilon(\lambda)$ Extinction coefficient.
- c Concentration of the gas sample
- d Distance measured through the sample

The Beer's Law calculation is performed by the patient monitor's software.

Conditions of Use

The Poet Plus 8100 patient monitor is calibrated with dry NIST-traceable calibration gasses at room temperature and pressure (~ 21C, 740 mmHg). Given the small effect of water vapor upon the CO_2 measurement and the unit's built-in temperature and pressure measurements and compensations, this monitor's method of gas analysis per EN 864 is best described as ATPS (Ambient Temperature and Pressure, Saturated; 21C, 750 mmHg, 100% Humidity Saturated).

The monitor is suitable for sustained pressure (breathing circuit) monitoring environments and has been tested per Clause 102 (Sustained Pressure) of EN 864.

Stability of Accuracy

The monitor has an internal barometer and thermistor that allow compensation for changes over a range of temperature and atmospheric pressures. The monitor complies with EN 864 standards for cyclical pressure. The module as installed in the Poet Plus 8100 patient monitor has been clinically tested for performance with a variety of patients.

N_2O Compensation

The patient monitor has a manual N_2O compensation feature for a fixed N_2O value of 60%. The user may select N_2O compensation when 40-80% N_2O is in use.

Measuring Oxygen (O_2)

The Poet Plus 8100 patient monitor uses the sidestream method of measuring O_2. The gas is sampled from the same gas intake system used in CO_2 monitoring. The water trap removes moisture and particulate matter from the gas samples.

Method

The gas sample is measured using a reactive oxygen cell. The oxygen sensor is a galvanic electrochemical cell that works by a process known as “oxidation reduction.”

Oxygen from the air comes in contact with a highly reactive metal, reacts with the metal, and produces a current. As the oxygen reacts, this reactive metal is gradually used up. Once the metal is used up the depleted cell can no longer sense oxygen.

The cell generates a voltage output proportional to the amount of oxygen in the sampled gas. This oxygen cell has an internal thermistor and circuitry that adjusts the output voltage based on current temperature of the cell.

The voltage is read by the microprocessor and an O_2 measurement is generated using predictive circuitry. This predictive function enhances response time of the O_2 monitoring module.

The relationship between gas concentration and pressure is calculated by the microprocessor. The monitor displays the numerical value(*O2 Calculated*) generated using the following formula:

$$O_2\ \text{Calculated} = O_2\text{Measured} \times \frac{20.9}{O_2\text{Ambient}} \times \frac{P_C}{P_0}$$

The measured O_2 predictive value is multiplied by a fixed value derived from room pressure divided by room ambient oxygen levels. The measurement is further adjusted by multiplying the ratio of the pressure determined at calibration (P_C) with the current pressure (P_0).

There is a negligible effect on O_2 measurements due to humidity.

Conditions of Use

The O_2 function is appropriate for measuring respiratory O_2 concentrations in all patient populations. The O_2 monitor is suitable for use in breathing systems and with the use of inhalation anesthetic agents.

Stability of Accuracy

The oxygen cell contains temperature correction circuitry. The oxygen sensor temperature is maintained at a nominal 40 degrees Celsius to maintain a consistent performance.

Temperature Measurement

The patient monitor measures body temperature using a thermistor (temperature sensing elements in the temperature probe). The thermistor can sense changes in body temperature by changing electrical resistance.

- Unusual, fast artificial variations in temperature readings may occur with accompanying applications of an electrocautery system.
- Electrical leakage current of the cable when used with the monitor and sensor comply with IEC 601-1/EN 60601-1.

The monitor is compatible with any YSI-400 or YSI-700 series temperature probe.

Specifications

ECG

Connectors:	3 or 5 Lead, Standard AAMI
Lead Selection:	3-Lead; I, II, III
	5-Lead; I, II, III, aVR, aVL, aVF, V
ECG Sensitivity	Low, Medium, High
Frequency Response:	Diagnostic; 0.05 - 100 Hz (-3db) Monitor(ESU); 0.50 - 40 Hz (-3db) ST Filter; 0.05 - 40 Hz (-3db)
Electrosurgery Protection:	Yes
HF Equipment Protection:	Yes
Defibrillator Protection:	Yes
Pacer Detection/Rejection:	Yes

SpO_2

Range:	1-99%
Resolution:	1%
Accuracy:	70-99% range; ± 2%; 50-69% range; ± 3% <50%; unspecified; Statistical, represents one st. dev. (~66%) of clinical samples.
Indications	Plethysmograph, Numerical, Audible (pulse tone pitch varies with SpO_2)
Method:	Dual wavelength LED
Modes:	Adult/Pediatric/Neonate
Operation:	Continuous Use
Sensor Wavelength:	660nm/905nm
Sensor Power:	<80mW

Heart Rate

Source:	Smart Switching; ECG(primary), IBP, Pleth, NIBP,
Range:	20-300 bpm(ECG, IBP, Pleth) 30-240 bpm (NIBP)
Accuracy:	± 1 bpm or 1%
Pulse Tone:	Selectable, On/Off

Respiration

Source:	Selectable; ECG, CO_2 or Smart Switching (CO_2 primary)
Rate Range:	6 to 150 breaths/minute
Resolution:	1 breath/minute
Accuracy:	> of ± 1% or ± 1 breath/minute

Invasive Blood Pressure

Channels:	2
Transducer Sites:	Selectable; ART, PA, LA, RA, CVP, ICP
Pressure Range:	-20mmHg to 300mmHg
Transducer Sensitivity:	5µV/V/mmHg
Resolution:	1 mmHg
Accuracy:	±1 mmHg or ±1%, whichever is greater
Scale Range:	-10 to 10, 0 to 20, 0 to 30, 0 to 40, 0 to 60, 0 to 100, 0 to 150, 0 to 200, 0 to 300, and Auto Ranging

NIBP

Technique:	Oscillometric measure upon inflation
Measurement Time:	<40 seconds average; standard adult cuff
Automatic Measurement Cycles:	2, 3, 5, 10, 15, 30, 60 min; 2, 4 hrs
Inflation Pressure Range:	Adult; 0 to 300 mmHg Pediatric; 0 to 300 mmHg Neonatal; 0 to 150 mmHg
Resolution:	1 mmHg
Transducer Accuracy:	± 2 mmHg or 2% of reading
STAT mode:	5 min. of consecutive readings

Capnometry (CO_2)

Units:	mmHg; Percent; kPa; Torr
Display:	Inspired CO_2, Expired CO_2 (End-Tidal) Numerical values, capnogram, and breath by breath $ETCO_2$ bar graph.
Method:	Sidestream Non-dispersive Infrared
Calibration:	Auto-calibrating, Manual Calibration
Waveform Scale:	Selectable, percent only 0 to 3.13, 6.25, 12.5 or 25%
Range:	0 to 99 mmHg, 0 to 12.5%, 0 to 12.5 kPa, 0 to 99 Torr
Resolution:	1 mmHg, 0.1%, 0.1 kPa, 1.0Torr
Accuracy:	± 2 mmHg, ± 0.3 vol%, ± 0.3 kPa, ± 2 Torr @ 150 ml/min & RR <=35 Br/min
N_2O Compensation:	User Selectable
Flow rate:	50 ml/min or 150ml/min, User Selectable
System Response Time:	1.7 seconds @ 150 ml/min, 4.6 seconds @ 50 ml/min
Rise Time:	(10-90%) 350 milliseconds @ 150 ml/min, 500 milliseconds @ 50ml/min
Delay Time:	1.3 seconds @ 150 ml/min, 4.0 sec. @ 50ml/min
Time from cold start:	15 sec. (including auto-calibration) to first reading; 30 sec. to ± 1.0 vol%, 2.5 min. to ± 0.5 vol%; 5 min. to full accuracy
Pneumatic Sound Pressure:	54 dBa maximum @ 1 meter

Oxygen Monitoring (O_2)

Units:	Percent
Display:	Inspired O_2, expired O_2 Numerical values only
Method:	Oxidation-reduction galvanic cell
Range:	0-100%
Resolution:	1%
Accuracy:	± 3 vol% (0-100%)
System Response Time:	1.7 seconds @ 150 ml/min
Rise Time:	(10-90%) 600 milliseconds @ 150 ml/min
Flow rate:	50 ml/min or 150ml/min, User Selectable

Temperature

Channels:	2
Range:	68° - 113°F, 20° - 45°C
Accuracy:	68° - 94.9°F, 20° - 34.9°C; ± 0.5% 95° - 107.5°F, 35° - 41.9°C; ± 0.2% 107.6° - 113°F, 42° - 45°C; ± 0.5%
Probe Type:	YSI-400 or YSI-700

Alarms

Characteristics:	EN 475, Adjustable
Indication:	Audible; Visual
Levels:	High, Medium, Low, Informational
Settings:	User Defaults, Hospital Defaults, Factory Defaults
Alarm Modes:	Adult/Pediatric/Neonate, High and low limit settings for each mode.
Volume:	User Adjustable (1-10)
Silence:	Yes; 2 minutes or permanent

Trend Reports

Types:	Tabular and Graphical
Trend memory:	24 hours
Tabular Intervals:	30 sec., 1, 2, 5,10, 30 min., 1, 2, 4 hrs. User Selectable (Serial output includes 1, 2, 5, 10, 15, and 20 seconds.)
Graphical Span:	2, 4, 8, 12, or 24 hours
Data Types:	BPM, HR, SpO_2, Temp., Resp., $ETCO_2$, $INCO_2$, Expired O_2, Inspired O_2, NIBP (Systolic, Diastolic, Mean) IBP (Systolic, Diastolic, Mean)

Printer

Recorder Type:	Internal thermal line printer
Data Formats:	Single or dual waveform; Tabular
Paper Speed:	12.5 or 25mm/sec. continuous. (Snapshot at 50mm/sec.)

Controls

Screen:	10.4" active color TFT
Resolution:	640 x 480 pixels
Waveforms:	6, maximum
Waveform Display Gain:	0.5x, 1x, 2x, 4x user selectable
Waveform Sweep Speed:	6.25, 12.5, 25 or 50 mm/sec., selectable
Keys:	9; membrane-activated
Rotary knob:	Push and rotate; 24 steps/turn
Languages:	Eng., Fr., Ger., It., Port., Span.

System Outputs

Com Ports:	RS 232-compatible; digital DB9 (COM 1); mini-DIN8 (COM 2)
Analog Output:	mini-DIN8, Selectable waveform output, Range: -2 to 3 volts, ECG Waveform (1 volt signal); Plethysmograph or Capnogram
Nurse Call	Contact switch; audio jack 1/8 inch, 24V @ 100 ma maximum switching
Defibrillation Sync:	BNC connector
Video Port:	Serial VGA Compatible
External Module Port:	Hypertronics connection

Mechanical/Electrical

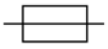
Weight:	12 lb; 5.45kg
Size:	12" (H) x 10.5" (W) x 7.5" (D) 30.5cm (H) x 26.7 cm (W) x 19.1cm (D)
Mechanical Shock:	Negligible effect up to 40G
Vibration:	Negligible effect up to 0.5G at 200Hz
Power Requirements:	35W, typical
Voltage:	100-240, VAC; 50/60 Hz
Number of Batteries:	Up to 2 sealed lead acid batteries (will operate with one battery)
Battery Life:	1 hr., typical (one battery without using gas feature)
Recharge time:	4.5 hours

Environmental

Operating Temperature:	59° - 95°F, 15° - 35°C
Storage Temperature:	23° - 122°F, -5° - 50°C
Operating and Storage Humidity:	15% to 90%; non-condensing
Type of Protection:	Class I Equipment
Degree of Protection:	Type CF, Defibrillator-Proof
Protection against ingress:	Ordinary; (Complies with the ingress protection test specified in EN 60601-2-27 ECG Safety Standard.)

All specifications are subject to change without notice.

Symbols

Symbol	Definition
	Refer to Operator's Manual for Information
CE 0413	European Community Mark
	Underwriters Laboratories Mark
	Not For Use with Flammable Anesthetic Gasses
	Do not dispose of in municipal waste. Wheeled bin symbol indicates separate collection for electrical and electronic equipment. (WEEE Directive 2002/96/EEC)
	Type CF Equipment, defib proof
	Shock Hazard
	Fuse
	Alternating Current (AC)
	Technical Support Phone Number

Definitions for Warning and Caution symbols:

⚠DANGER⚠ Designates an imminent danger. Non-observance is likely to lead to death or the most severe injuries.

⚠WARNING⚠ Designates a possible dangerous situation. Non-observance may lead to death or the most severe injuries.

⚠CAUTION⚠ Designates a possible dangerous situation. Non-observance may lead to minor injuries or damage to the product.

Safety

⚠WARNING⚠

- Read this manual entirely before attempting clinical use of the monitor.
- A possible explosion hazard exists! Do not use the monitor in the presence of flammable anesthetics.
- Cables, cords, and leadwires may present a risk of entanglement or strangulation! Verify safe and proper positioning of these items after patient application.
- Unapproved modifications to the monitor may cause unexpected results and present a hazard to the patient.
- Risk of electrical shock! Do not remove cover. Refer servicing to qualified personnel.
- U.S. Federal law restricts this device to sale by or on the order of a physician.

⚠CAUTION⚠

- Use the monitor only with recommended accessories! Use of unapproved accessories may cause inaccurate readings.
- Equipment accuracy may be affected at extreme temperatures.
- Do not store equipment at extreme temperature. Temperatures exceeding specified storage temperatures could damage the system.
- Do not press on the buttons with surgical instruments or other tools. Sharp or hard objects could damage the buttons. Use only your fingertips to press on the buttons.
- Changes or modifications not expressly approved by Criticare Systems, Inc., may void the user's authority to operate the equipment and may also void the warranty.

Leakage Current

The monitor complies with leakage current limits required by medical safety standards for patient-connected devices. Conforms to EN 60601-1. A hazard caused by the summation of leakage currents is possible, when several pieces of equipment are interconnected.

Voltage Fluctuations

When operated in the line voltage range specified in this manual any fluctuation has a negligible effect. Very low line voltage causes the monitor to revert to battery power. Very high line voltage may cause damage to the charger circuits. The monitor is designed with circuitry that turns the unit off before spurious readings can be caused by a low battery condition.

Software Error Related Hazard Mediation

Criticare Systems, Inc., has quality control practices and procedures in place to review potential hazards as they relate to software. The monitor is Year 2000 Compliant and utilizes a 4 digit year for all date, time, and leap year calculations.

Potential Interference

This device has been successfully tested to IEC 601-1-2 specified levels for emissions of and resistance to electromagnetic energy fields. External disturbances which exceed these levels may cause operational issues with this device. Other devices which are sensitive to a lower level of emissions than those allowed by IEC 601-1-2 may experience operational issues when used in proximity to this device.

MAGNETIC FIELDS
Use of the monitor in an MRI environment may interfere with MRI image quality. Use of MRI may interfere with the monitor.

RADIO FREQUENCY INTERFERENCE
The monitor conforms with IEC 1000-4-3 for radio frequency interference, and will operate with negligible adverse effects.

CONDUCTED TRANSIENTS
The monitor conforms with IEC 1000-4-4, and IEC 1000-4-5 for conducted transients, and operates with negligible adverse effects.

X-RAY
The monitor operates with negligible adverse effects in an x-ray environment. However, the monitor should not be placed directly in the x-ray beam, which could damage the internal electronics of the monitor.

OTHER INTERFERENCE
There is a negligible adverse effect to the monitor from electrocautery and electrosurgery, infrared energy, and defibrillation.

Use of Anesthetics

Do not use this device in conjunction with flammable anesthetics such as cyclopropane and ether. The monitor can sample from pure oxygen environments, but the monitor itself should never be placed inside an oxygen tent or gas containment apparatus. Proper anesthetic gas waste recovery should be used.

Biocompatibility

All patient-contact or user-contact materials in this monitor and it's accessories have passed ISO 10993-5, -10, & -11 biocompatibility tests or have been in use in clinical environments in large numbers over an extended period of time predating these standards.

Latex Content

All Criticare Systems, Inc., products, including patient monitors and accessories, are free from latex in any location that may result in patient contact.

Section 2 — Service Windows

Service Mode Window

The monitor has a *Service Mode* window that is accessible through the *CONFIG* window of the monitor.

⚠WARNING⚠

- Never service a monitor while it is attached to a patient.
- Never enter the service menu while monitoring a patient.

Service Mode Window

To access the Service Mode located in the *CONFIG* window:

1. Press the ON/OFF button on the front panel to turn on the power to the monitor.
2. Rotate the menu knob to highlight *CONFIG* in the main menu and press the knob once to select it. The *CONFIG* window appears.

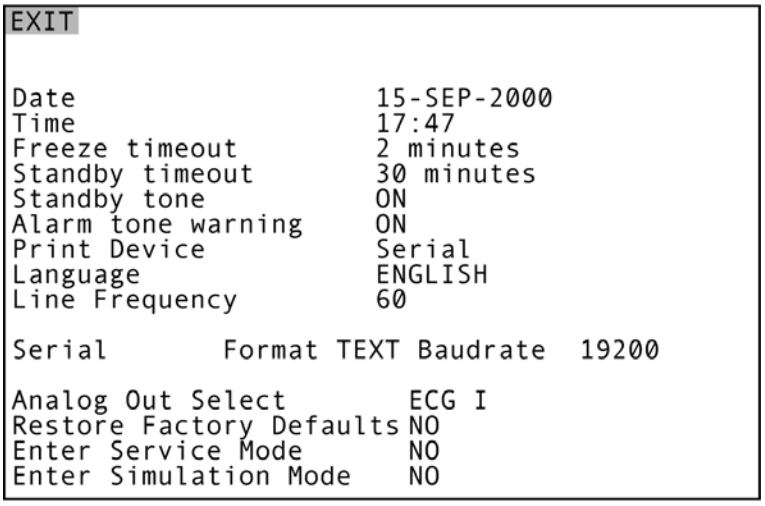


Figure 2-1: *CONFIG* (Configuration) Window

3. Rotate the menu knob to highlight *Enter Service Mode* and press to select. The value *NO* is highlighted.

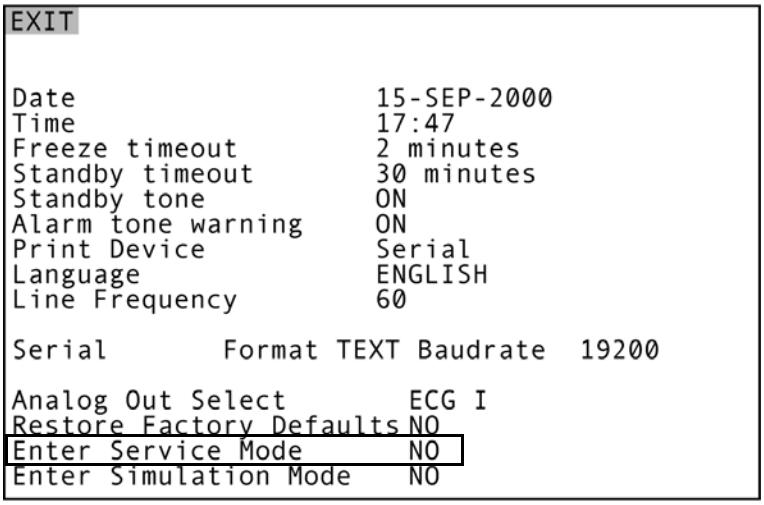


Figure 2-2: *CONFIG* Window, *Enter Service Mode* Highlighted

4. Rotate the menu knob to highlight *YES* and press to select. The *Enter Service Mode* dialog box appears.

Figure 2-3: *Password* Window for Service Mode

5. To enter the service mode enter the password `PIA418` by doing the following:
   - Rotate the menu knob to select a character.
   - Press the menu knob to enter each character.
   - If a mistake is made, advance to the end of the password and start over.

     When you enter the correct password, the *Service Mode* window appears. (See the next step.)

If you entered an invalid password, the window below appears. Check the validity or spelling of the password you entered and repeat the password entry.

Figure 2-4: *Invalid Password* Window

6. When you enter a valid password the *Service Mode* window appears:

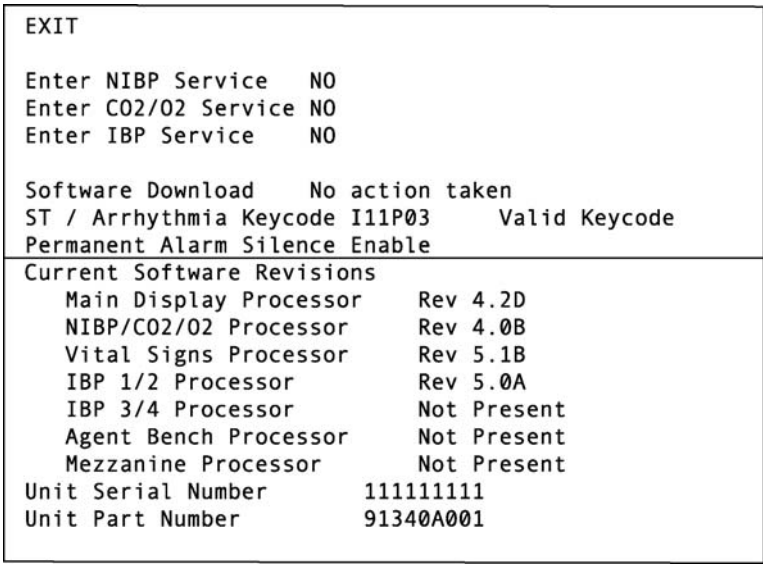

EXIT
Enter NIBP Service NO
Enter CO2/O2 Service NO
Enter IBP Service NO
Software Download No action taken
ST / Arrhythmia Keycode I11P03 Valid Keycode
Permanent Alarm Silence Enable
Current Software Revisions
Main Display Processor Rev 4.2D
NIBP/CO2/O2 Processor Rev 4.0B
Vital Signs Processor Rev 5.1B
IBP 1/2 Processor Rev 5.0A
IBP 3/4 Processor Not Present
Agent Bench Processor Not Present
Mezzanine Processor Not Present
Unit Serial Number 111111111
Unit Part Number 91340A001

Figure 2-5: *Service Mode* Window

From this point, you can access all service mode functions and calibrations, set operation values, and perform tests. All the following functions are accessed from the *Service Mode* window shown above:

- NIBP Service Mode
- CO_2/O_2 Service Mode
- IBP Service Mode
- Processor Software Download
- ST/Arrhythmia Keycode *
- Permanent Alarm Silence

NOTE: After you perform each service mode function, you must turn off power to the monitor. Press the ON/OFF button on the front panel of the monitor.

* **NOTE**: See “Addendum 1 — Arrhythmia and ST Analysis” in the Operator Manual for information.

NIBP Service Mode

From the *Service Mode* window, do the following:

NOTE: To service the NIBP module you need specified equipment. See **Section 6** for details.

1. To run a high time or pressure test for adults or infants, or to run an inflate/deflate speed test, with the menu knob highlight *Enter NIBP Service* and press to select. The value *NO* is highlighted.
2. Rotate the menu knob to highlight *YES* and press to select. The *NIBP Service Mode Parameters* window to service NIBP appears.

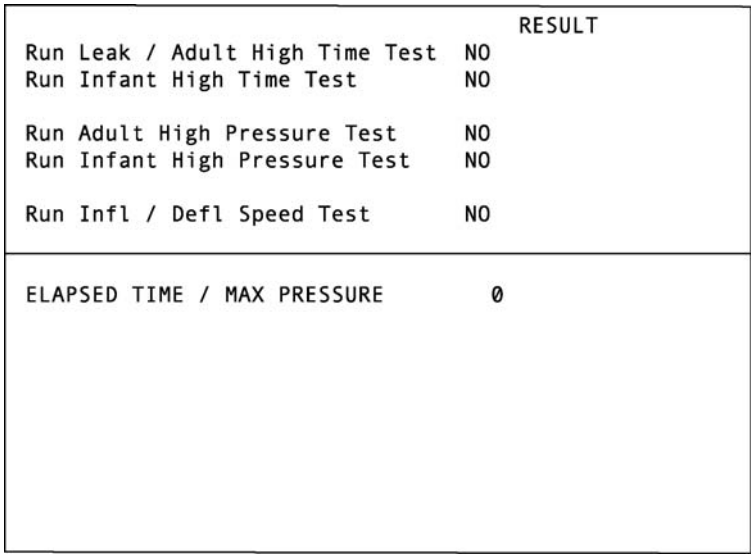

RESULT
Run Leak / Adult High Time Test NO
Run Infant High Time Test NO
Run Adult High Pressure Test NO
Run Infant High Pressure Test NO
Run Infl / Defl Speed Test NO
ELAPSED TIME / MAX PRESSURE 0

Figure 2-6: *NIBP Service Mode Parameters* Window

3. Rotate the menu knob to highlight the test you want to run and press to enter. The test value *NO* is highlighted.
4. Rotate the menu knob to highlight *YES* and press to begin the test. When the test is executing, the following message appears on the bottom of the *NIBP service* window:
   Test in progress, select YES to cancel
5. Press the ON/OFF button on the front panel of the monitor to turn off power to the monitor.

CO_2/O_2 Service Mode

From the *Service Mode* window:

NOTE: To service the CO_2/O_2 module you need specified equipment. See **Section 6** for details.

1. To calibrate and adjust the gas module of the monitor, with the menu knob highlight *Enter CO_2/O_2 Service* and press to select. The value *NO* is highlighted.
2. Rotate the menu knob to highlight *YES* and press to select. The *Service Mode* window appears to provide functions and settings to calibrate and adjust the CO_2 and O_2 modules of the monitor. The window is shown below:

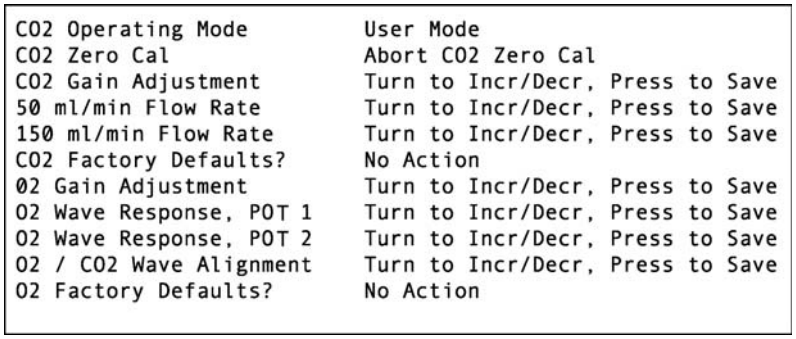

CO2 Operating Mode User Mode
CO2 Zero Cal Abort CO2 Zero Cal
CO2 Gain Adjustment Turn to Incr/Decr, Press to Save
50 ml/min Flow Rate Turn to Incr/Decr, Press to Save
150 ml/min Flow Rate Turn to Incr/Decr, Press to Save
CO2 Factory Defaults? No Action
02 Gain Adjustment Turn to Incr/Decr, Press to Save
O2 Wave Response, POT 1 Turn to Incr/Decr, Press to Save
O2 Wave Response, POT 2 Turn to Incr/Decr, Press to Save
O2 / CO2 Wave Alignment Turn to Incr/Decr, Press to Save
O2 Factory Defaults? No Action

Figure 2-7: CO_2/O_2 Service Mode Window

3. Press the ON/OFF button on the front panel of the monitor to turn off power to the monitor.

IBP Service Mode

From the *Service Mode* window, do the following:

NOTE: To service the IBP module you need specified equipment. See **Section 6** for details.

1. To start or restart CAL, store CAL results, and set mmHg Point values, with the menu knob highlight *Enter IBP Service* and press to select. The value *NO* is highlighted.
2. Rotate the menu knob to highlight *YES* and press to select. The *Service Mode* window appears to provide functions and settings for IBP.

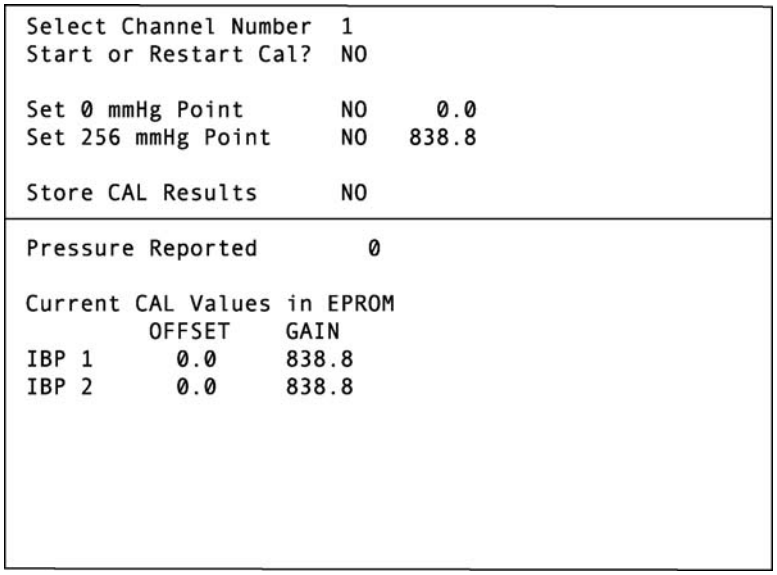

Select Channel Number 1
Start or Restart Cal? NO
Set 0 mmHg Point NO 0.0
Set 256 mmHg Point NO 838.8
Store CAL Results NO
Pressure Reported 0
Current CAL Values in EPROM
OFFSET GAIN
IBP 1 0.0 838.8
IBP 2 0.0 838.8

Figure 2-8: *IBP Service Mode* Window

3. Press the ON/OFF button on the front panel of the monitor to turn off the power to the monitor.

Processor Software Download

Use the *Software Download* parameter from the *Service Mode* window to download software for the following processors:

- Main Display Processor
- IBP 1/2 Processor
- NIBP/CO_2/O_2 Processor
- Vital Signs Processor

From the *Service Mode* window:

1. Select the processor you wish to download.
2. Rotate the menu knob to highlight *Software Download* and press to select. The value *NO* is highlighted.

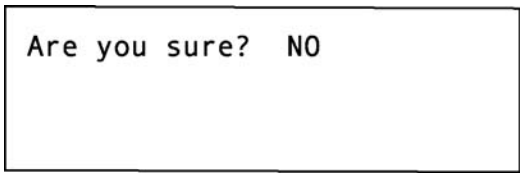


Figure 2-9: *Initial Software Download* Dialog Box

3. Rotate the menu knob to highlight *YES* and press to select. The following window appears:

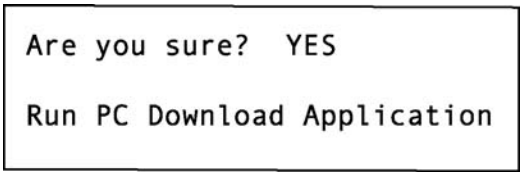


Figure 2-10: *Software Download Response* Message

   If you choose not to select *YES*, allow *NO* to remain selected, and then press the menu knob to return to the *Service Mode* window. The following message then appears next to the *Software Download* parameter:

   No action taken

4. Press the ON/OFF button on the front panel of the monitor to turn off the power to the monitor.

Permanent Alarm Silence

From the *Service Mode* window:

1. To disable the permanent alarm silence feature, with the menu knob highlight *Permanent Alarm Silence* and press to select. *Enable* is highlighted.
2. Rotate the menu knob to highlight *Disable* and press to select.
3. Press the ON/OFF button on the front panel of the monitor to turn off the power to the monitor.

NOTE: Read about the override capability of the *Permanent Alarm Silence* function over the *Alarm Tone Warning* function in “Alarm Tone Warning” on page 2-10.

⚠CAUTION⚠

- Before you disable this safety feature, contact your local distributor because the Permanent Alarm Silence tone is required in certain countries.

Service Settings

Several settings on the *CONFIG* window are password protected. You should not change these functions during use and only biomed technicians or supervisory personnel should adjust the settings. These functions include:

- Standby Timeout
- Alarm Tone Warning
- Line Frequency
- Enter Service Mode
- Enter Simulation Mode

To set the functions listed above, do the following:

1. Rotate the menu knob to highlight *CONFIG* in the *Main* menu and then press the knob once to select it. The *CONFIG* window appears..

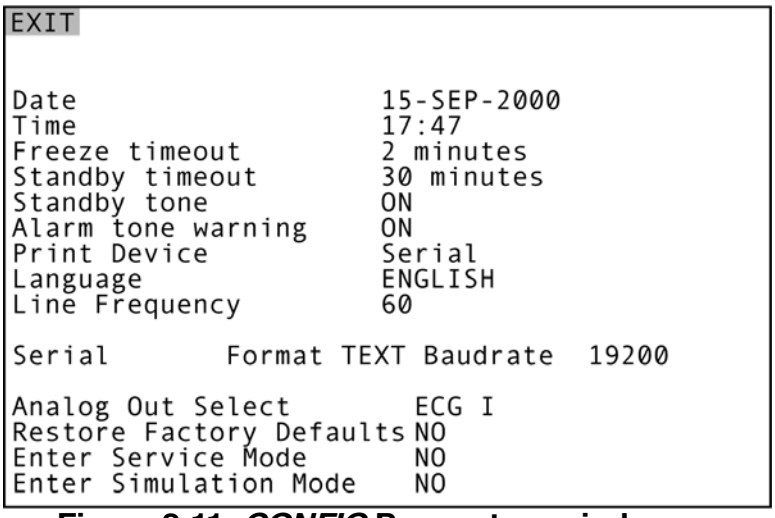


Figure 2-11: *CONFIG* Parameters window

2. Rotate the menu knob to highlight the service function that you want and press to select.

Service Password

To enter the service mode enter the password `PIA418` by doing the following:

1. Rotate the menu knob to select a character.
2. Press the menu knob to enter each character.
3. If a mistake is made, advance to the end of the password and start over.

Standby Timeout

You can set the *Standby Timeout* value to disable the monitor from 5 minutes to 2 hours. (Factory default value is 30 minutes.)

If you select *OFF* you cause the STANDBY key to disable the monitor permanently until you press the STANDBY key again.

Alarm Tone Warning

Set the *Alarm Tone Warning* value to *ON* to allow the monitor to produce a low-pitched double beep every 2 minutes after a new alarm activates.

Set the *Alarm Tone Warning* value to *OFF* to allow the monitor to suspend any audible alarm (remain silent) after a new alarm activates. Thus you can silence alarms with a “long” push (held in for 2 seconds) on the monitor’s SILENCE key.

NOTE: As a safeguard measure, the *Permanent Alarm Silence* function (*Service Mode* window) can override the *Alarm Tone Warning* function. The *Disable* value of the *Permanent Alarm Silence* function can prevent the ability of the *Alarm Tone Warning* function’s *OFF* value to suspend audible alarms. In this case, pushing the Silence button has no effect; the monitor’s full audio alarm would continue. Set this safeguard according to your facility protocols and according to local safety regulations for medical devices.

Override from the *Service Mode* Window: *Permanent Alarm Silence*	**Configuration Window: Alarm Tone Warning**	
	ON	**OFF**
ENABLE	double beep	always silent
DISABLE	full audio alarms	full audio alarms

Line Frequency

In the *CONFIG* menu the frequency which is rejected is either 50 Hz or 60 Hz. Set the frequency to the local AC (mains) power which is 60 Hz in the U.S. and 50 Hz in most of Europe. Contact your local distributor for more information. The password to change the frequency is PIA418.

Simulation Mode

Simulation software is only used for demonstrations and not intended for servicing the monitor. The service password is required to activate this demonstration function. The words *SIMULATION MODE* appear in large letters on the monitor screen when in use.

In the sample window shown below, all function parameters are active and reflected in the waveforms and numerical values that could be useful for a demonstration or training session.

NOTES: The data for halothane and nitrous oxide is shown in the lower right-hand corner of the sample window. Though it is equiped to display anesthetic gas values, the monitor must receive that data from an external module or device that is not included with the monitor. For more information, contact your local CSI dealer or the Criticare customer service department.

The screen only displays functions that are available on the unit.

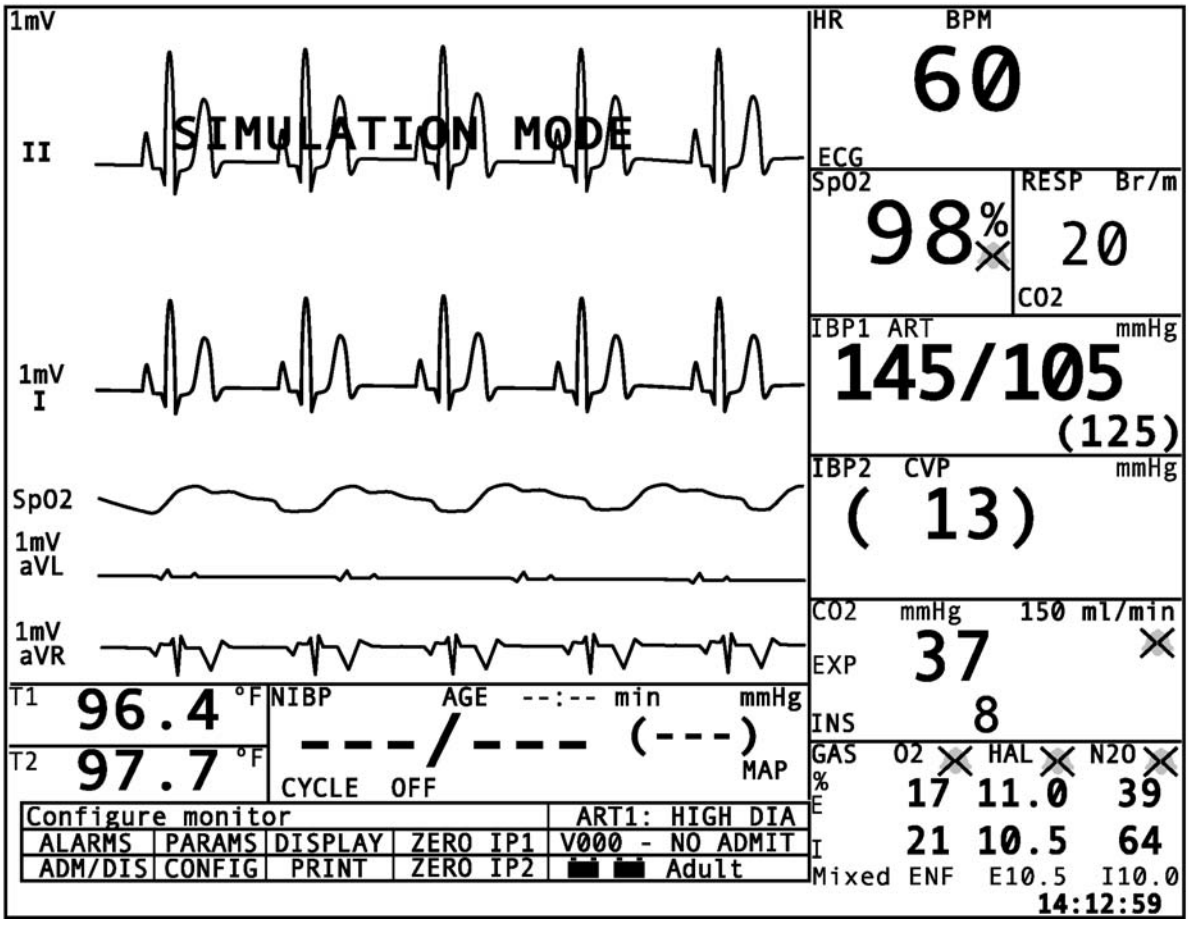


Figure 2-12: Example of the Window in Simulation Mode

Custom Profiles

The monitor has a set of default settings that you can configure to the needs of the facility. These default settings are password protected.

Setting Patient Size

The monitor is designed to look at the patient size information selected in the *ADM/DIS* window and determine whether the monitor should use one of the following alarm settings while monitoring:

- Adult
- Pediatric
- Neonatal

When you change the patient size in the *ADM/DIS* window or the *ALARMS* window, the monitor determines which window appears when you select the *ALARMS* softkey. When the user changes patient size the user effectively changes all the alarm limits for all of the following:

- SpO_2
- ECG
- NIBP
- IBP
- Temperature
- Respiration
- CO_2
- O_2
- Maximum NIBP pressure limit.

To enter patient size, do the following:

1. Rotate the menu knob to highlight *ADM/DIS* and press to select.
2. Rotate the menu knob to highlight *Update*, select *YES*, and press to select. You can now select the patient data field.
3. Rotate the menu knob to highlight *Patient Size* and press to select.
4. Rotate the menu knob to highlight *Adult*, *Pediatric*, or *Neonate* as required.

   Optional: Enter a value for unit label only if you use central station communication.
5. Select *EXIT* to return to the *Main* window.
6. Exit the *ADM/DIS* window.

Creating Custom Profiles

The default mode you last completed is the default patient size for custom defaults. If you want a different default size mode, change the order in which the monitor saves alarm limits.

In the example below, the first patient size setting created is *NEONATE*. Update the custom default alarm limits for the pediatric and adult modes by repeating the steps in this procedure, two more times, once for *PEDIATRIC* and once for *ADULT* as the patient size setting.

ACCESSING THE DEFAULTS DIALOG BOX

After setting the patient size (e.g., *NEONATE*), start from the main window to access and set the defaults for your facility's custom profile:

1. Press and hold the DEFAULT button on the front panel for approximately two seconds. The *Set Unit Defaults* dialog box appears.

   NOTE: If the *Set Unit Defaults* dialog box that prompts you to enter a password did *not* appear, you did not hold the button in properly. In this case, with the menu knob highlight and select *CANCEL* or you could lose the settings you just created.

2. Enter the password `LIA608` by doing the following:
   - Rotate the menu knob to select a character.
   - Press the menu knob to enter each character.
   - If you make a mistake, advance to the end of the password and start over.
   - After you press the menu knob for the last character of the password, the monitor indicates acceptance of the password by displaying the *Set Unit Defaults* window.
   - When the *Set Unit Defaults* window displays, both *SELECT* and *CUSTOM DEFAULTS* are highlighted.

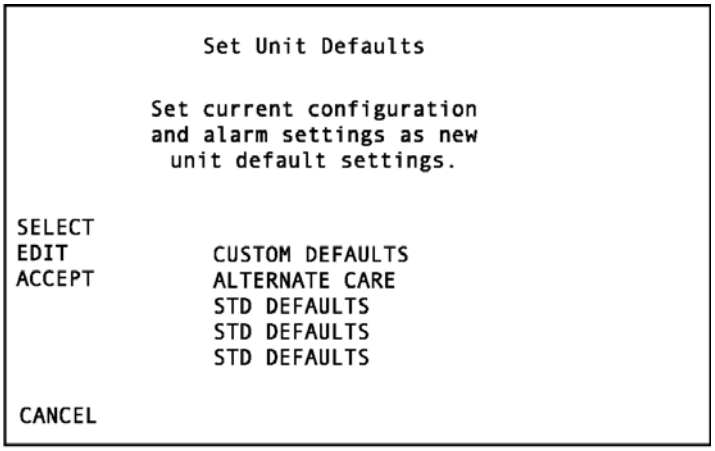


Figure 2-13: Set Profile Before Modifications

ENTERING THE NEW PROFILE TITLE

3. With both *SELECT* and *CUSTOM DEFAULTS* highlighted in the *Set Unit Defaults* window, rotate the menu knob to highlight *EDIT* and press to select.
   - As you rotate the menu knob, *CUSTOM DEFAULTS* remains highlighted.
   - The first letter of *CUSTOM DEFAULTS* is highlighted.
4. Change the label *CUSTOM DEFAULTS* (for example, to the title *FACILITY DEFAULTS*) by doing the following:
   - With the letter *C* highlighted (the first letter of *CUSTOM DEFAULTS*), rotate the menu knob to highlight the letter *F* (the first letter of the example *FACILITY DEFAULTS*) and press to select. The next letter automatically highlights.
   - Continue for the remaining letters of the new title.
   - After completing the last letter in the title (in this example, it would be the letter *S*), press the menu knob until the entire label name highlights. This indicates that the entry is complete but not accepted.

ACCEPTING THE NEW PROFILE TITLE

5. To accept the new label name, rotate the menu knob to highlight *ACCEPT* and press to select. The message *Action Completed* appears.

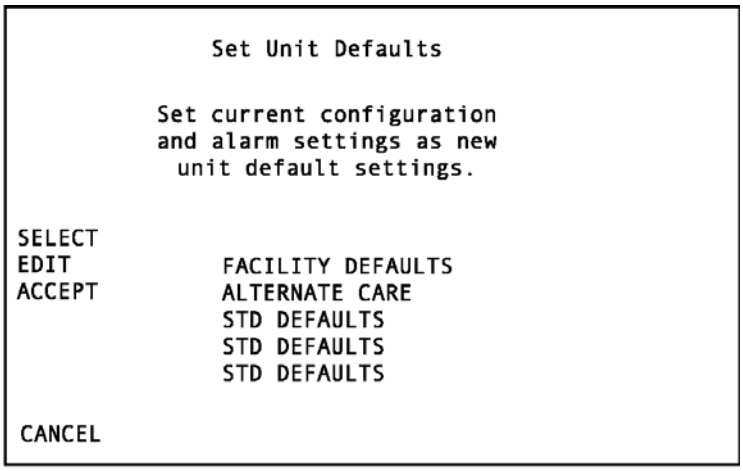


Figure 2-14: Set Profile After Modifications

6. Press the menu knob. Your set of defaults are saved in memory.
7. Press the ON/OFF button on the front panel of the monitor to turn off the power to the monitor.

Section 3 — Theory of Operation

Power Module

The patient monitor employs a universal switching power supply for international use.

In order to monitor the status of the line power, and condition of the battery pack, the internal power supply circuitry drives several status lines available to the main module. The power management/ watchdog circuit provides a low battery level detection mechanism and a hardware-based check on software operation (watchdog timer).

Main CPU and System

The microprocessor circuitry handles the Main Board computational functions and provides integrated I/O functions, including timers, I/O pins, serial interfaces, and analog I/O.

The CONM module contains a microprocessor and associated circuitry for NIBP and the ability to control the optional Capnometer Module. No electrical connection is made with the patient from the monitor for NIBP. The vital signs parameters are passed to the main module using a serial channel.

Vital Signs Module

The vital signs module is a single printed circuit board with connectors to the Main Board, the ECG input leads, the SPO_2 connector, and the temperature sensor. The vital signs module contains a microprocessor, and associated circuitry for pulse oximetry, temperature, ECG signals, and TTI respiration. ECG signals can be either 3-lead single channel, or 5-lead triple channel. Patient isolation for galvanic contact is required for the temperature and ECG functions. Patient isolation for non-galvanic contact is required for the pulse oximetry sensor. A CAN bus passes the vital signs parameters to the main module.

The main module sends the vital signs module control information and the vital signs module sends the main module waveforms and hardware status. The communication cycle is 20 Hz for the vital signs information from the VS module, twice a second for the status of the VS module, and as needed for the control information from the main module.

Speaker Driver

The speaker drive circuit is a DAC controlling speaker volume and an output pin to control frequency. A software-controlled timer generates a square-wave signal that drives the speaker. Hence, any drive frequency has harmonic components, and generates no “pure tones.” Applicable standards recommend against the use of pure tones in alarm situations to reduce the risk of an individual with a “notch” hearing deficit missing an alarm.

ECG Module

The ECG module monitors from either three-lead or five-lead surface electrode configuration, providing one or three concurrent ECG leadviews, respectively. The ECG module processing includes heart rate, ECG lost, pacer pulse, and leadoff detection. The main software is able to control lead, gain/scale, and filter selection, as well as pacer mode operation. Shielding, both on the PCB and external to it, reduces the impact of ESU noise on signal quality and heart rate calculation. The following issues were important in the design of the ECG module:

- Diagnostic-quality signal bandwidth;
- reliable beat detection and heart rate calculation;
- ESU noise rejection;
- pacemaker pulse detect; and
- artifact rejection

The ECG module uses a differential amplifier to extract surface ECG activity from a pair of electrodes. Input to the amplifier is protected against damage from excessive voltages. Passive filtering reduces high power RF interference from electrosurgical devices. Hardware under software control performs filtering for monitor vs diagnostic modes, lead selection, lead off detection, and pacer pulse detection. Software performs gain control, notch filtering to remove line frequency interference, pacer artifact handling, noise detection, beat detection, heartrate calculation, and serial (CAN bus) communications.

Impedance Respiration

The TTI respiration circuit uses a transformer to generate a low current, high frequency stimulus through the Lead I electrodes. The resulting voltage variations reflect impedance variations across the thorax, which in turn reflect respiration activity (as well as other phenomena including cardiogenic artifact and motion artifact).

The TTI respiration software performs low pass filtering, high pass filtering, breath detection, and calculates breath rate.

Pulse Oximeter Module (SpO_2)

The pulse oximeter is based upon the principle of dual-wavelength photoplethysmography. Red and infrared LEDs are alternately driven to illuminate some (relatively well-perfused) tissue site, and a photodetector receives either the transmitted or reflected light, resulting in a current flow. This input signal is demultiplexed with sampling in the monitor to separate the red and infrared components. The wavelengths are chosen to permit discrimination of oxygenated and deoxygenated hemoglobin, based on the difference in their absorbance spectra.

In a “pulse” oximeter, a high-passed AC component is extracted from each of the red and infrared signals, and digitally processed to detect the pulsations corresponding to blood flow in the illuminated tissue. The AC and DC components in red and infrared, measured near the time of pulsation, are combined in a relatively simple ratiometric formula (obtained, with many assumptions, by solving Beer’s law equations with empirically derived coefficients) to yield a figure proportional to SpO_2. The pulse rate is also calculated from the pulse intervals detected.

Capnometer Module (CO_2)

The capnometer contains the circuitry for monitoring the sidestream CO_2 level by actively sampling from the patient’s airway. It contains provisions for interfacing with galvanic oxygen monitoring option sub-modules. No electrical connection is made with the patient from the monitor for capnometry. The CONM module controls the capnometer.

The CO_2 Board contains an assembly known as a “bench.” This bench contains the optics, IR source, detector, sample cell, and optical filters. The purpose of this bench is to convert CO_2 levels in a gas sample to electrical signals.

The bench assembly utilizes the principle of infrared absorption spectrometry to measure the amount of CO_2 in patients breath. Infrared absorption spectrometry is widely used in gas analysis. Using a phenomenon explained in “Beers Law,” CO_2 gas absorbs certain wavelengths of infrared energy with the amount depending on the amount of CO_2 gas. A detector, outfitted with an infrared bandpass filter, only allows a certain wavelength of infrared energy that the CO_2 gas absorbs. As the CO_2 concentrations in the sampled air passes through the sample cell, the detector senses the infrared energy changes and converts them to an electrical signal. This electrical signal is then amplified and conditioned and sent to a microprocessor for processing and then sent to a display.

The CO_2 Board also uses a reference channel. The purpose of this reference channel is to “cancel” the effects of IR source changes, sample cell contamination, temperature, etc. The only difference from the CO_2 channel is that the detector is outfitted with an optical filter that is tuned to a band in the infrared spectrum that is transparent to CO_2 and other gases typically found in the medical industry. The signal from the reference channel is processed similarly to that of CO_2 measurement channel.

The CO_2 and reference detectors work by an effect known as "pyroelectric." Pyroelectric effect works by changing energy levels, either increasing or decreasing, that are imposed on a sensing element. The detector is outfitted with an optical bandpass filter that passes only a narrow band of a determined wavelength of infrared energy. The infrared source is modulated at 15 hertz (Hz) to provide varying energy for the detector and amplifier circuits.

Correction for temperature and pressure effects on the CO_2 sample is implemented to maintain accuracy over a wide temperature and atmospheric pressure range.

Galvanic Oxygen Sub-Module (O2)

The galvanic oxygen-monitoring sub-module contains the control and signal acquisition circuitry for monitoring the O_2 level in the airflow drawn by the capnometer module. It is an optional daughter board on the capnometer module. No electrical connection is made with the patient from the monitor for oxygen monitoring.

Temperature

The temperature module measures probe resistance and uses an internal data table for looking up temperature conversions. Depending on the user's selected settings the monitor calculates the temperature in Fahrenheit or Celsius. The conversion value displays on the video screen.

Communications

The monitor provides two patient-isolated external RS-232 serial data ports (TX, RX, and ground):

- The DB-9 COM1 port is configured for compatibility with ASCII printer applications.
- The DIN-8 COM2 port is custom-configured with one pin reserved for analog output.

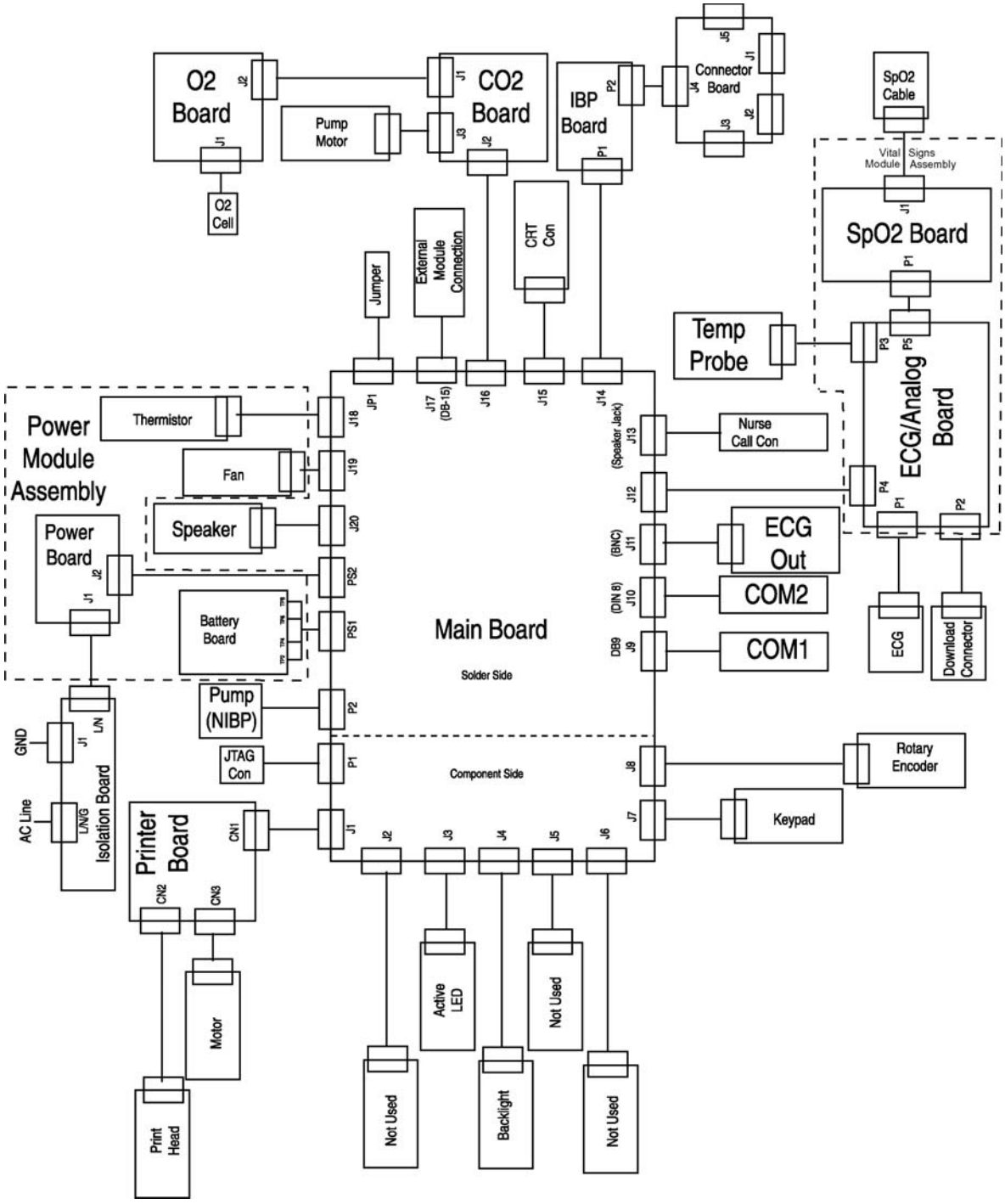
The main module drives a patient-isolated external analog output. It provides a 0 to 1 v output capable of driving a high-level input, such as a defibrillator or chart recorder.

Printer

The Main Board powers and controls the printer module. The Main Board processes error messages from the Printer Board and displays them on the screen. The internal printer module is a Sieko LTP1245-type mechanism.

Block Diagram

The following block diagram aids in tracing communication and data routes within the system. Connection numbers are given to show the relationship between the boards. The diagram is keyed to the theory of operations found on the previous pages.



Section 4 — Cleaning and Disinfecting

Cleaning and Disinfecting

⚠WARNING⚠

- Shock Hazard! Before cleaning a monitor and sensor, turn the power off and disconnect the AC power cable.
- Shock Hazard! Never immerse the monitor because the monitor has an internal power source that is active even when the unit is unplugged.

Do not use abrasive cleaners on the monitor or on any sensors or probes. Abrasive cleaners damage the monitor, sensors, and probes.

With the exception of the display screen, wipe clean the exterior surface of the monitor with alcohol. Dry it with a soft, dry cloth. Because paper towels or tissues can scratch the surface of the display, use a cotton cloth to clean the monitor.

Do not use full-strength alcohol on the display screen. Repeated use of strong cleaners damages the screen. Clean the display window by wiping it clean with a soft, lint-free cloth sprayed with common glass cleaner, hwoever, do not spray glass cleaner directly on the display.

Pulse Oximeter Sensors

⚠CAUTION⚠

- Do not immerse any Criticare pulse oximeter sensor connector in any liquid because it damages the connector.

The SpO_2 sensor can be wiped clean with alcohol. Disinfect the SpO_2 sensor by placing the paddles and cable in a 2% glutaraldehyde solution. Only the sensor paddles and cable are placed in the solution.

Blood Pressure Cuffs

You can clean the reusable blood pressure cuff by wiping it with a damp cloth or sponge. If necessary, disinfect the cuff by wiping it with 70% alcohol, mild bleach solution, or other disinfectant.

Disposable blood pressure cuffs are for single patient use and are not intended to be disinfected.

You can sterilize the cloth cuff and neoprene bag with commercially available disinfectants such as ethylene oxide (ETO). Rinse thoroughly to remove residual disinfectants. Do not allow liquids to enter the neoprene bag. The cloth cuff can also be sterilized in an autoclave.

If the cuffs become grossly soiled with blood or other body fluids, you should launder the cloth cuffs by hand or machine. You can launder or sterilize the dacron cloth cuff by first removing the neoprene inflation bag. Feed the inflation tube back through the hole and then pull out the cloth flap.

Figure 4-1: Remove Inflation Bag from Cuff

Roll up the inflation bag and slide it out the open slot in the cloth cuff. The following laundering precautions apply only to non-disposable cuffs. You should not launder disposable cuffs and neoprene inserts.

- Remove the inflatable bag from the cuff before laundering or sterilizing the cuff.
- Close the Velcro® fastener before you launder the cuff.
- Strong bleach solutions damage the cuff.
- Temperatures over 275° F (135° C) damage the cuff.
- Soaking the cuff in dark-colored solutions may stain or discolor the cuff.

Hand laundering (as opposed to machine laundering) prolongs the life of the cuff. Wash the cuff in warm, soapy water. Rinse the cuff thoroughly. After you clean the cuff, allow the cuff to air dry, then insert the inflation bag in the cuff.

ECG Cable

You can clean the ECG cable and leads with alcohol. Do not immerse the connections.

Temperature Cable

Clean the cable according to the hospital protocol for cleaning of reusable equipment cables.

Typically this protocol consists of the following steps:

1. Disconnect the cable from the monitor and temperature sensor.
2. Wipe the cable with a nonabrasive cloth moistened with a mild detergent and warm water or a disinfectant.
3. Dry thoroughly.

4. Do not use alcohol or solvents to clean the cable.
5. Do not allow the cable connectors and contact points to come in contact with liquids.
6. Do not fully immerse the cable in liquids.
7. Do not autoclave or ETO sterilize the cable.

Accidental Wetting

⚠WARNING⚠

- Shock Hazard! Because a monitor is an AC-powered device, an immersed monitor presents a danger to anyone who attempts to handle the device.

Immediately perform the following steps following an accidental wetting of equipment:

1. Turn the power off. Disconnect the AC power cord from the monitor.
2. If the monitor is monitoring a patient, transfer the patient to another monitor as quickly as possible.
3. Use a clean, dry towel or cloth to remove the liquid from the monitor housing.
4. A service technician should inspect the monitor as soon as possible.
5. If the internal mechanism is saturated, allow the liquid to drain out for 24 hours before shipping.
6. If liquid has entered the monitor, it must be dried and cleaned internally. Full testing is required before you can use the monitor. Contact the CSI service department as soon as possible.

Time is critical. The longer any liquid remains in the monitor, the more damage it can do. It is important to service the monitor immediately after any liquid is spilled into it.

Section 5 — Preventative Maintenance

Incoming Inspection

You must inspect monitors coming back from service for shipping damage before you place them into operation just like newly purchased monitors. The monitor should be free from dents, cracks, or other physical damage. The quality inspection seal of the monitor should be unbroken, indicating that the monitor has been tested according to manufacturer's specifications.

If further incoming inspection or testing is required, the manufacturer recommends that you use the Alarms Verification (located in this section) as an incoming inspection test. You can perform additional electrical safety testing in this section as part of an incoming inspection in accordance with the policies of the health care provider.

Maintenance Schedule

Every Patient	• Clean and disinfect the sensor cables and sensor. • Inspect the accessories and cables for damage. • Change the gas sampling device and sampling line.
Every Day	• Charge the monitor's batteries.
Every Week	• Change the water trap. (Or change as needed.)
Every 3 Months	• Clean the exterior of the unit (or clean as needed). • Check the O_2 cell. Change, if necessary.
Every Year	• Perform the annual safety tests provided in this section. • Verify the CO_2 auto-calibration. Calibrate, if necessary. • Change the O_2 cell. • Check the CO_2 absorber. Change, if necessary. • Check the gas flow rate. Adjust, if necessary.

Monitor Safety Testing

You can perform the following tests as part of a periodic safety check. The following safety tests are designed so that the monitor's warranty seal does not have to be broken. If the monitor fails any portion of these tests, contact the CSI service department.

The contents of this section, "Preventative Maintenance," include the following verifications and safety tests:

- Withstanding Voltage (Hi-Pot)
- Electrical Leakage
- Ground Continuity
- Interface Inspection
- Manual Controls Check
- Alarm Verification
- Vital Sign Modules Verification
  - ECG
  - SpO_2
  - NIBP
  - Temperature
  - Gas Flow/CO_2/O_2
  - IBP
- Internal Printer
- Communications
- Battery and Power

Criticare recommends that you run a serviced monitor for the following time periods before you perform the tests listed above and place the monitor back into service:

- Cat 8100 Family with CO_2/O_2 requires 48 hours.
- Cat 8100 Family without CO_2/O_2 requires 24 hours.

Repaired modules could require more extensive testing than what is shown in this list.

Always follow ESD precautions when performing a procedure discussed in this section.

⚠WARNING⚠

- Because test procedures require working with exposed electrical circuits, only experienced electrical or biomedical technicians should perform the procedures.
- After a monitor is altered through repair or hardware adjustment, you must fully test it before use.

Equipment and Tools

The following procedures assume that the technician has an ESD safe workbench, a set of electronic hand tools, and a digital multimeter with a 10 amp setting. At the beginning of each test, special equipment can be listed. A variety of customized cables, clips, and test fixtures are also needed to complete the tests. For more information, contact the CSI Service Department.

Accessory Testing

Check patient cables (e.g., temperature cables, printer cables) monthly for damage, loose wires/connections, loose connectors, cracked housing, etc.

Check the electrical safety of the power cord as part of the monitor safety testing.

Check the cuffs for leakage as part of the NIBP verification.

Battery Safety

The batteries require no maintenance. For more information, refer to the *Poet® Plus 8100 Patient Monitor Operator's Manual*.

⚠CAUTION⚠

- Do not short circuit the battery terminals! The resulting high-current discharge can cause burns.
- Charge the battery completely after extended battery use to ensure a fully-charged battery is available for the next use.
- Explosion hazard! Keep lighted cigarettes, sparks, and flames away from the battery.
- The battery contains sulfuric acid electrolyte that can cause severe burns and eye damage, as well as illness from sulfur oxide fumes.
- Do not crack, cut, burn, or dissolve (with solvents) the battery case. Damaging the battery case can cause the release of sulfuric acid. If sulfuric acid is released from the battery, wear eye protection and rubber gloves to handle the battery, and use a solution of baking soda in water to neutralize the sulfuric acid.
- The used battery is a potential environmental hazard and must be disposed of properly. Dispose the old battery in accordance with local and federal laws. Do not incinerate.

Battery Replacement

The battery access door is on the lower left side of the monitor.

1. Open the battery access door.
2. Lift up a battery's locking tab and then slide it out of its individual bay. Do this for both batteries.

Figure 5-1: Raise the Lock Tab to Remove a Battery

As you remove each battery note that the battery contacts are located at the end of the battery.

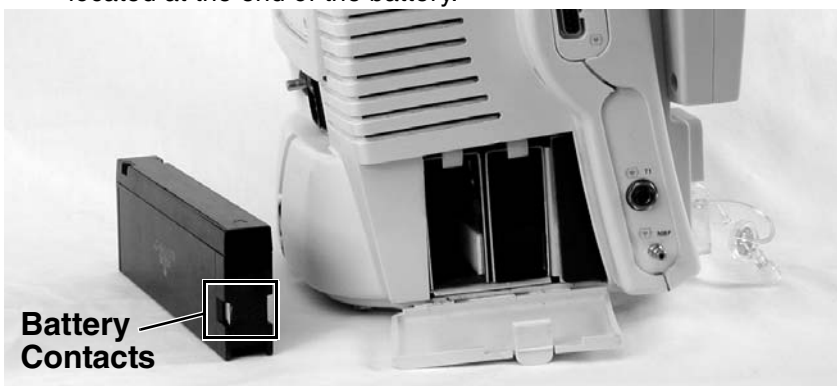


Figure 5-2: Battery Contact Location

3. To replace a battery, lift up the locking tab and sliding the battery into the bay. The contact end of the battery goes in first.

Figure 5-3: Replacing a Battery

Fuse Removal/ Replacement

There are two AC power fuses located at the rear of the monitor directly above the AC power entry socket.

- United States monitors use 1A 250V Slo Blo fuses.
- International monitors used in 220-240 volt environments use 0.5A 250V Slo Blo fuses.

4. Press in the side clips (at the same time) with a tool and lift out the small, black access cover. The two fuse sockets are visible.

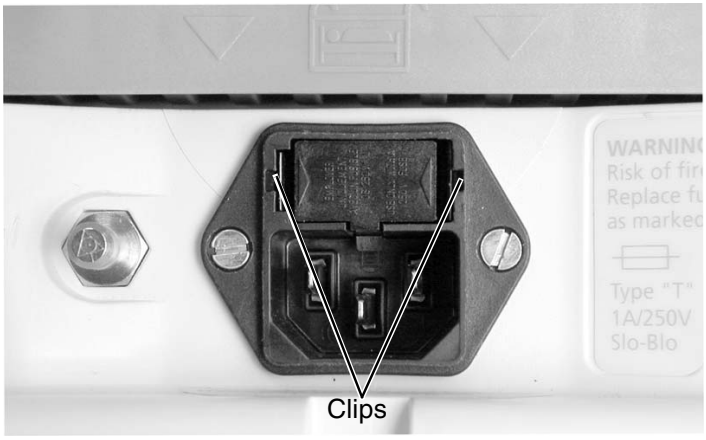


Figure 5-4: Remove the Fuse Cover

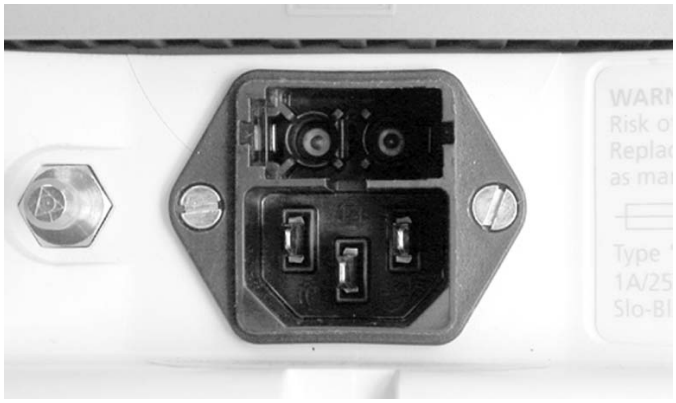


Figure 5-5: Fuses Exposed

5. Gently pull the fuses out of the fuse cover assembly.

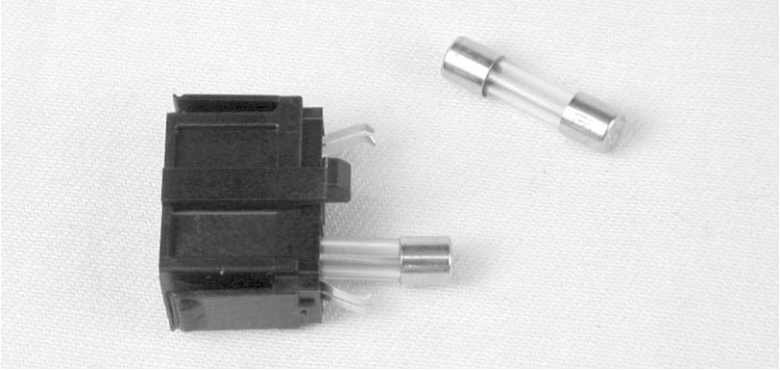


Figure 5-6: Fuses Pulled

6. Reassemble in reverse order.

For more information about troubleshooting power problems, refer to “Troubleshooting” in Section 8 in this manual.

Oxygen Sensor Replacement

⚠CAUTION⚠

- Use a properly grounded ESD dissipating wrist strap during the replacement process to prevent static damage to the sensitive electronic circuits.

1. Turn the monitor's power off.
2. Remove the two Phillips screws from the rear access door.
3. Use a flathead screwdriver to pry the rear access door off the back of the monitor.

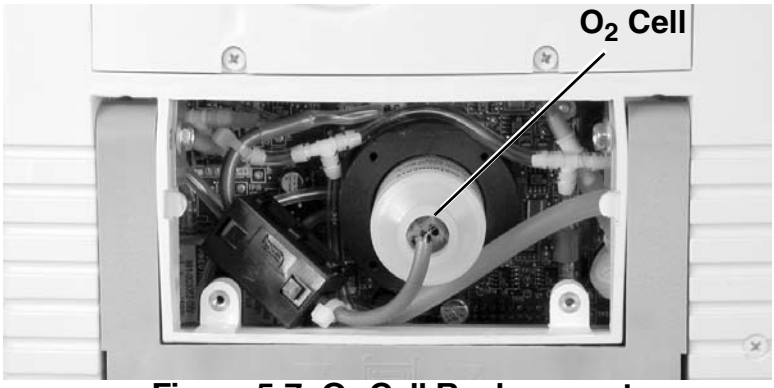


Figure 5-7: O_2 Cell Replacement

NOTE: Later model units have the CO_2 absorber mounted directly on the inside of the rear access door. It is not necessary to disconnect the absorber or the exhaust port tube.

4. With your fingernail carefully pull the brown connector from the O_2 cell body. Unscrew the expired O_2 cell and dispose of it.

NOTE: Use only replacement O_2 Cell, CSI Catalog #644.

Figure 5-8: Oxygen Sensor (O_2 Cell)

5. Carefully screw in the replacement O_2 cell. Do not over tighten this screw (¼ turn is recommended.). Observe the polarity and carefully plug the cable back into the top of the O_2 cell.
6. Check the exhaust line and absorber tube for proper connection.
7. Replace the rear access door. Tighten the screws.

8. Turn the monitor's power on and let it warm up for at least one hour before you make response or gain adjustments. Failure to allow this warm-up can result in inaccurate adjustments.
9. Perform an O_2 User Calibration for both the 50 ml/min and 150 ml/min. See "O2 Calibration" on page 6-12.

CO_2 Absorber Replacement

The CO_2 absorber removes CO_2 from air samples during calibration. These samples provide a base line for the measurement of ambient CO_2.

1. Turn off the monitor.
2. Do not use the monitor for five minutes.
3. Remove the two Phillips screws from the rear access door.
4. Use a flathead screwdriver to pry the rear access door off the back of the monitor.
5. Look for the CO_2 absorber. It is a clear tube containing light colored granules.
   a. For early units, the absorber is located to the left of the O_2 board and tie-wrapped to a valve assembly.
   b. For later units, the absorber is attached directly to the access panel door.

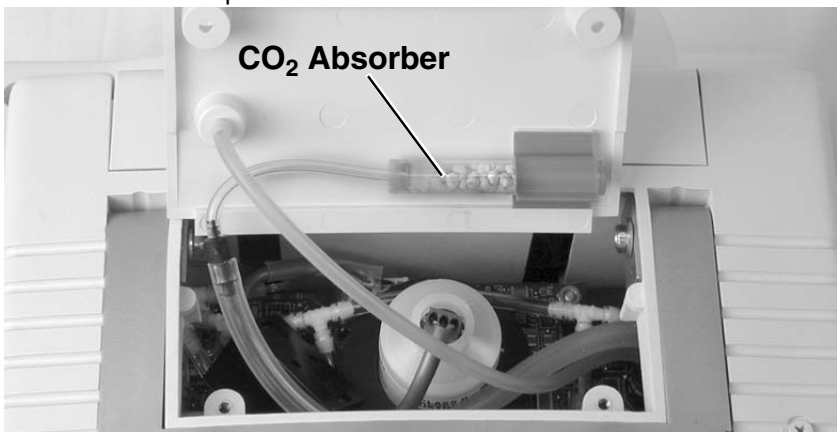


Figure 5-9: CO_2 Absorber (Newer Models)

6. The granules are normally white, indicating a good absorber. If the granules remain violet or blue, the absorber is expired and you must replace it.

   NOTE: The absorber can change color during use, but should always return to its original white color when not in use.

7. Remove the expired CO_2 absorber where it attaches to the larger diameter tube.
8. Replace with pn 40570B003. For early units you must disassemble the monitor to remove and replace the absorber. Refer to the disassembly instructions which are located in “Disassembly” in Section 7 of this manual.

   NOTE: The end of the absorber has a small opening that must remain unblocked as a sampling port during calibration.

Long-Term Monitor and Battery Storage

No special preparation is necessary for long term storage of the monitor. Although you do not have to remove the battery from the monitor for long term storage, the battery drains to an unrecoverable state after 3 months without periodic charging.

Monitor and Accessories Disposal

At the end of its useful life, you can dispose of the monitor and its accessories according to your institution's policies and procedures for disposal of patient-contact medical waste.

Alternately, you can return the monitor and its accessories to Criticare Systems, Inc., for safe disposal. The shipping address is:

Criticare Systems, Inc.
20925 Crossroads Circle, Suite 100
Waukesha, WI 53186

Electrical Safety Testing

Perform this test each time you open the monitor housing and before you use the monitor on patients.

⚠WARNING⚠

- Shock Hazard! Because dangerous and lethal voltages are present during the withstanding voltage, leakage, and ground continuity test, all leakage and voltage testing must be done with the monitor housing in place. For complete information about the proper operating and safety procedures, refer to the *Poet Plus 8100 Patient Monitor Operator's Manual.*

Equipment Needed

The following are needed to complete this procedure:

- Kikusui TOS 8750 Withstanding Voltage Tester (or equivalent Hi-Pot tester)

Withstanding Voltage (Hi-Pot) Test Equipment and Setup

The following test and set-up is for the Kikusui TOS 8750 Withstanding Voltage Tester. If you use an equivalent tester, use the factory recommended test for that tester.

1. Test the Withstanding Voltage Tester by connecting the red and black lead together. Set the voltage to 1000 VAC.
2. Set timer for 1 second and cutoff current for 1 milliamp.
3. Press the **Test** button. The NG light should come on.

⚠CAUTION⚠

- If the NG light does not come on, do not continue with this test. You must repair or replace the withstanding voltage tester.

Withstanding Voltage (Hi-Pot) Test Procedure

1. Connect the red lead of the Withstanding Voltage Tester to **Hot/ Neutral** and the black lead to **Chassis Ground**. Set the Withstanding Voltage Tester to a **Trip Current** of 1mA and test @2600VDC.
2. Connect the red lead of the Withstanding Voltage Tester to **Hot/ Neutral** and the black lead to **Secondary Ground** (BNC). Set the Withstanding Voltage Tester to a **Trip Current** of 1mA and test @5656VDC for 1 minute.
3. Connect the red lead of the Withstanding Voltage Tester to **Hot/ Neutral** and the black lead to **ECG Ground Isolated**. Set the Withstanding Voltage Tester to a **Trip Current** of 1mA and test @6800VDC.
4. Connect the red lead of the Withstanding Voltage Tester to **Hot/ Neutral** and the black lead to **IBP Ground** (special test connector is required). Set the Withstanding Voltage Tester to a **Trip Current** of 1mA and test @6800VDC.
5. Connect the red lead of the Withstanding Voltage Tester to **Hot/ Neutral** and the black lead to the **Nurse Call** Ground (special test connector is required). Set the Withstanding Voltage Tester to a **Trip Current** of 1mA and test @6800VDC.
6. Connect the red lead of the Withstanding Voltage Tester to the **ECG ISO Gnd** and the black lead to the **Secondary GND** (BNC). Set the Withstanding Voltage Tester to a **Trip Current** of 1mA and test @4242VDC for 1 minute.
7. Connect the red lead of the Withstanding Voltage Tester to the **ECG ISO Ground** (special test connector is required) and the black lead to the **Chassis (AC) GND**. Set the Withstanding Voltage Tester to a **Trip Current** of 1mA and test @2600VDC.
8. Connect the red lead of the Withstanding Voltage Tester to the **Secondary GND (BNC)**. and the black-lead to the **Chassis (AC) GND**. Set the Withstanding Voltage Tester to a **Trip Current** of 1mA and test @707VDC for 1 minute.
9. Connect the red lead of the Withstanding Voltage Tester to the **EPT** and the black lead to the **SPO2 Ground** (special test connector is required). Set the potentiometer (Hipoter) to a trip point of 1mA and test for @2600VDC.
10. Connect the red lead of the Withstanding Voltage Tester to the **EPT** and the black lead to the **Temp1** or **Temp 2 Ground** (special test connector is required). Set the potentiometer (Hipoter) to a trip point of 1mA and test for @2600VDC.

Leakage Test Equipment and Setup

Perform all testing with the cover on. The following test requires a Dynatech 232D leakage tester or equivalent.

1. Perform a self-test, if applicable, on the DYNATECH 232D by plugging it into 110 VAC outlet. Turn on the leakage tester. Set the mode switch to self test. Display should read 1000 ±20 and the *CURRENT SOURCE ACTIVE* lamp should be on.

⚠CAUTION⚠

- If these conditions are not met, do not continue with this test.

2. Set the mode switch on the Dynatech 232 to **L1-L2** (line voltage). The display should read the line voltage ±10%. Set the mode switch to **L1-GND**. The display should read no more than 5% of **L1-L2** on a grounded power system. Set the mode switch to **L2-GND**.

   NOTE: This should read about the same as the **L1-L2** reading for a grounded system.

Leakage Test Procedure

The monitor must be powered up during all of the isolation tests.

1. Turn the mode switch to **CASE LEAKAGE GROUND CONDUCTOR**. Connect the AC cord from the Dynatech 232D to the monitor, and turn on the unit. With the **POLARITY** switch in the **NORMAL** position, press **OPEN GROUND** and monitor the readout for less than 500 microamps.
2. Change the polarity switch to the **REVERSE** position, press **OPEN GROUND** and monitor the meter for less than 500 microamps.
3. With the **POLARITY** switch in the **NORMAL** position, press **OPEN NEUTRAL** and **OPEN GROUND** switches and monitor the meter for less than 1 milliamp.
4. Change the **POLARITY** switch to the **REVERSE** position and press the **OPEN NEUTRAL** and **OPEN GROUND** switches and monitor the meter for less than 1 milliamp.
5. Connect the Dynatech 232 to the 8100 using the 5 lead ECG cable marked **Cat 1075/S**. Change the **MODE** switch to **ECG**.

   For the rest of the Leakage test insure that the leads are dressed away from the ground planes and the AC power cords and the chassis. Set the **LEADS** selector switch to **ALL TO GND**. Set the **POLARITY** switch to **NORMAL**. Monitor the meter for less than 5 microamps.
6. Set the **POLARITY** switch to **REVERSE** and monitor the meter for less than 5 microamps.

7. Set the **POLARITY** switch to **NORMAL** and press the **OPEN NEUTRAL** switch and monitor the meter for less than 10 microamps.
8. Set the **POLARITY** switch to **REVERSE** and press the **OPEN NEUTRAL** switch and monitor the meter for less than 10 microamps.
9. Set the **POLARITY** switch to **NORMAL** and press the **OPEN GROUND** switch and monitor the meter for less than 10 microamps. For inline voltages of 264V, meter for less than 20uA.
10. Set the **POLARITY** switch to **REVERSE** and press the **OPEN GROUND** switch and monitor the meter for less than 10 microamps. For inline voltages of 264V, meter for less than 20uA.
11. Turn the **LEADS** selector switch to the **ISO Position**. Turn the **POLARITY** switch to **NORMAL**, press the **ISO Test** button, and monitor the meter for less than 20 microamps. For inline voltages of 264V, meter for less than 50uA.

    Keep the power cord plugged into the unit under test and the Dynatech. Unplug the 8100 ECG cable from the front of the 8100. Unplug the ECG test leads from the Dynatech.

    Connect the $Sp0_2$ cable end to any of the **BROWN ECG** test terminals on the Dynatech.

    Connect the other end to the SPO2 connector on the EUT. MODE switch should be on ECG. Change the **LEADS** switch to **ISO**. Set the **POLARITY** switch to **NORMAL**.

    Press the **ISO** button and monitor the meter for less than 20 microamps. For inline voltages of 264V, meter for less than 50uA.
12. Keep the power cord plugged into the unit under test and the Dynatech. Unplug the 8100 ECG cable from the front of the monitor. Unplug the ECG test leads from the Dynatech.

    Connect the Temp cable end to any of the **BROWN ECG** test terminals on the Dynatech. Connect the other end to the TEMP connector into **T1** or **T2** connector of the EUT. Set the **MODE** switch to **ECG**. Change the **LEADS** switch to **ISO**. Set the **POLARITY** switch to **NORMAL**.

    Press the **ISO** button and monitor the meter for less than 20 microamps. For inline voltages of 264V, meter for less than 50uA.

13. Keep the power cord plugged into the unit under test and the Dynatech. Unplug the 8100 ECG cable from the front of the monitor. Unplug the ECG test leads from the Dynatech.

    Connect the IBP cable end to any of the **BROWN ECG** test terminals on the Dynatech.

    Connect the other end to the IBP connector on the EUT. MODE switch should be on **ECG**. Change the **LEADS** switch to **ISO**. Set the **POLARITY** switch to **NORMAL**.

    Press the **ISO** button and monitor the meter for less than 20 microamps. For inline voltages of 264V, meter for less than 50uA.

14. Verify that the green AC LED lights up on the front membrane.

Ground Continuity Test

This portion of the test requires a ROD-L Model 25 Ground Continuity Tester, or equivalent.

Do the following before turning on the ground tester:

1. Set the ground continuity tester to the resistance trip point setting of 0.1 ohms.
2. Set test time of 6 seconds. Set the tester to ground test only. Set the test current to 25 AMP's.
3. Turn on the ground tester.
4. Plug in the AC cord from the ground continuity tester to the monitor being tested.
5. Connect the ground cable to the chassis ground on the rear of the monitor.
6. Press the **Reset** button on the tester. Press the **Start** button.
7. The monitor passes if the Fail Light does not come on or if the resistance does not exceed 0.1 ohms during the test.

Functional Testing

Interface Inspection

This procedure is for the monitor's TFT active display.

1. Verify that a readable screen displays. For a guide to proper screen layout, refer to the *Poet Plus 8100 Patient Monitor Operator's Manual* for sample screens.
2. Verify that the screen display is clear and bright when you directly face the monitor.
3. Verify the image quality. There should be no intermittence or jittering of pixels. The maximum amount of pixels missing from any display are as follows:
   - Maximum number of bad dots allowed per screen is 7.
   - Maximum number of bad dots within any 20mm circle is 2.

Manual Controls Check

1. Verify that rotating the menu knob moves the cursor through the menu items. Verify that when you press the menu knob on a highlighted menu item the monitor displays a sub-menu.
2. Use the menu knob to enter the *CONFIG* window and set the date and time for the real time clock.
3. Press the FREEZE key. Verify that you get an audible response from the speaker. Press the FREEZE key again to unlock the waveforms.
4. Press the TREND key. Verify that you get an audible response from the speaker. A *Trend* window appears on the display. Press the TREND key again to close the *Trend* window. (Or optionally, press and hold the TREND key to open the *TYPE/INTERVAL/ SCREEN* menu that you close by selecting *EXIT*.)
5. Press the STANDBY key. Verify that you get an audible response from the speaker. A standby confirmation menu should appear. Press the STANDBY key again to close the menu.
6. Press the DEFAULT key. Verify that you get an audible response from the speaker. The *Custom Default* menu appears. Select *NO* and then select *EXIT* to return to the *Main* window.

Alarms Verification

To verify the alarm circuitry for SpO_2, perform the following procedure.

1. In the *PARAMS* window turn off all monitoring modules except for SpO_2. Set the display to show a plethysmograph waveform.
2. In the *PARAMS* window set the *SpO2 Low Limit Alarm* setting to *HIGH*. This sets the alarm priority for only this alarm parameter.
3. Use an SpO_2 simulator to set the monitor to display the plethysmograph waveform. Confirm the heart rate and saturation reading.
4. In the *ALARMS* window adjust the SpO_2 low alarm level above the saturation reading to cause an alarm condition.
5. Verify that the message *LOW SPO2* appears at the top of the waveform channel in red letters.
6. Verify that you get an audible response. The alarm should be a high priority alarm tone consisting of 3 beeps followed shortly by two beeps.
7. In the *PARAMS* softkey window, change the *SpO2 Low Limit Alarm* setting to *MEDIUM*.
8. Verify that the message *LOW SPO2* appears at the top of the waveform channel in yellow letters.
9. Verify that you get an audible response. The alarm should be a medium priority alarm tone consisting of 3 beeps.

ALARM VOLUME TEST

1. From the *ALARMS* window, vary the *ALARM VOLUME* through the ranges, from *OFF* to *10*. Verify that the speaker volume changes according to the setting of the *ALARM VOLUME*.
2. Press the alarm SILENCE key once. Verify that the low heart rate alarm stops for 2 minutes and that the 2-minute *Alarm Silence* icon appears in the system status area of the screen.
3. Press and hold the alarm SILENCE key for at least 2 seconds. Verify that the low heart rate alarm stops and the *Alarm Suspend* icon appears in the system status area of the screen.

Printer Check

The printer only prints if the green battery light is ON or the AC (mains) cord is plugged in.

1. Lift the paper feed lever up and insert paper. Close the lever and the paper should automatically feed.
2. Set the printer for *INTERNAL PRINTER* in the *CONFIG* window. Set print type for *TABULAR* in the *PRINT* window. Press and hold the PRINT key on the front of the monitor.
3. Verify that the correct date and time print.

Module Verification

ECG Verification

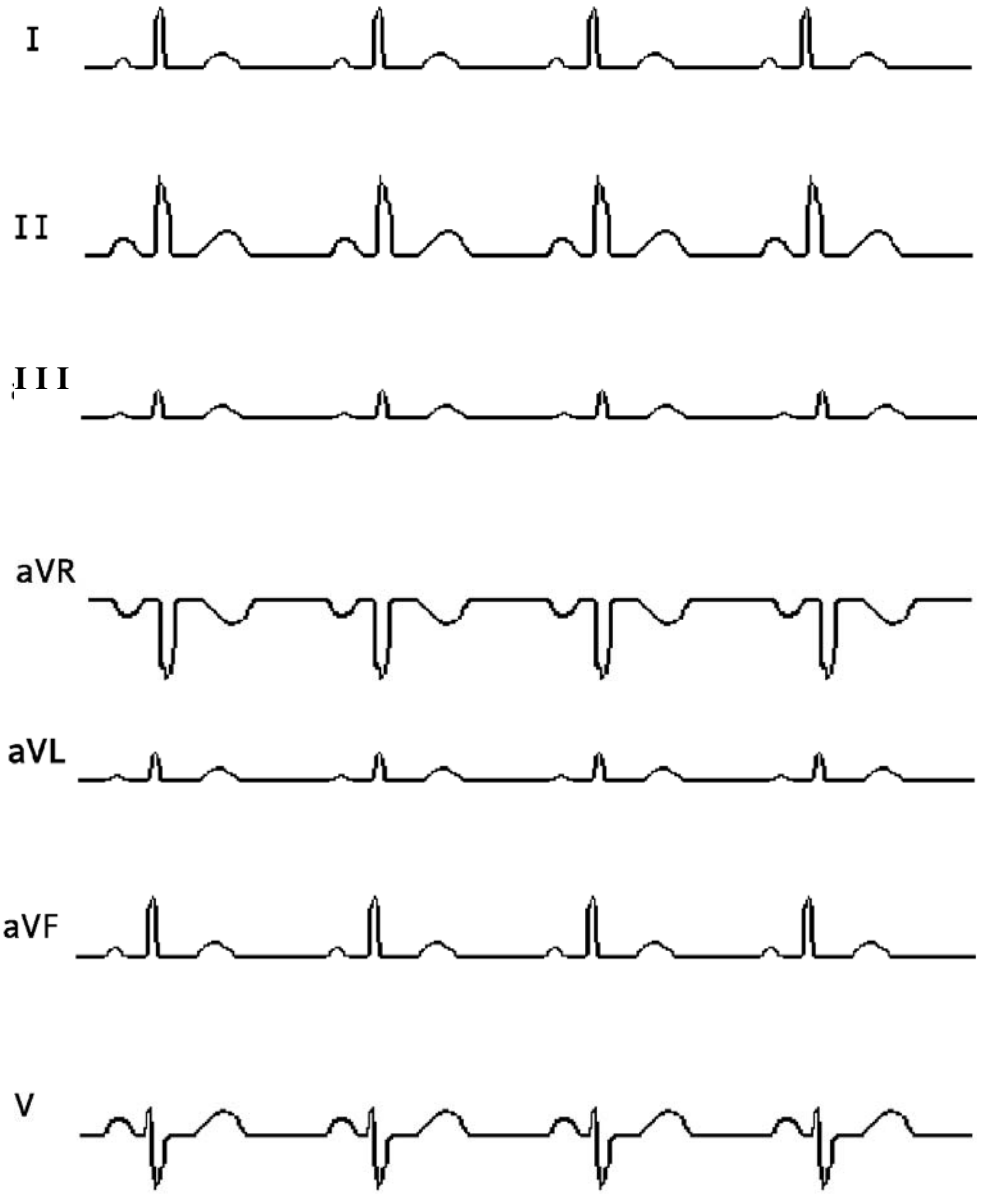
This test requires a Dynatech Nevada Model 300 simulator.

1. Select the menu to set up for *ECG PARAMS* to *5-Lead, ECG ON*, Filters: *MONITOR, SENSITIVITY* to *HIGH*.
2. Insert a shorted ECG cable into the ECG connector. Use the menu knob to enter the *DISPLAY* window. Set the following and use the current defaults for the size. They are 25MM except waveform 3:
   - Waveform 1 ECG I x 4.0 25.0
   - Waveform 2 ECG II x 4.0 25.0
   - Waveform 3 ECG V x 4.0 25.0
3. Exit the *DISPLAY* window. Verify that the baselines are centered. Verify that the base line signal is no greater than 3 pixels in height. Select the most solid line as the reference line and verify that this reference is less than ±3 pixels from the ECG y-axis center line. If they are not, refer to “ECG Analog Output Test” on page 5-24 to adjust them. Remove the shorted cable.
4. Verify that the message *LEADS OFF* appears at the top of the window when a cable is not connected.
5. Connect the 3-lead ECG patient cable CAT 1075/S to the ECG cable assembly, and use a Dynatech Nevada Model 300 simulator to turn on (ECG) normal sinus, 60BPM, amp 1.0mV, axis int. Respiration rate 20, and the impedance set for 0.5 ohms, and base impedance for 2K.
6. Rotate the menu knob to select *PARMETERS* and press to enable the menu. Select *ECG* for (*3 LEADWIRE*). Set the monitor for `LEAD II` waveforms. Check the following lead configurations for the following items:
   - Heart rate 60 ±3 BPM,
   - *RESPIRATION RATE* of 20 ±2 breaths per minute and
   - Correct waveform.

7. Rotate the menu knob to select *PARMETERS* and press to enable the menu. Select *ECG* for (*3 LEADWIRE*). Set the monitor for *LEAD II* waveforms.
   Check the following lead configurations for following items:
   - heart rate 60 ±3 BPM and
   - correct waveform.

8. Use the Electrode status error messages on the CRT to perform a lead off check in LEAD II.
   a. (LL) Red LL LEAD OFF
   b. (LA) Black LEADS OFF
   c. (RA) White RA LEAD OFF
9. Connect all the leads back on the simulator and select *ECG* to *5-lead*. Set the monitor for LEAD II waveforms. Disconnect the following leads one at a time and look for the proper status error message and for the waveform to continue or flatline.
   Reconnect the lead and the message should disappear and the waveform should return, if it flatlined.
   a. (V1) Brown V LEADS OFF
   b. (LL) Red LL LEADS OFF
   c. (LA) Black LA LEADS OFF
   d. (RA) White RA LEADS OFF
   e. (RL) Green LEADS OFF

10. Check the following lead configurations for following items:
    - Heart rate 60 ±3 BPM,
    - resp. rate 20 ±2 BPM and
    - correct waveforms.



11. Verify that the respiration rate changes from 20 to 30bpm, when changing on the MED SIM 300.

12. Rotate the menu knob to highlight *Display* and press to select. Under waveforms 3-6, Select:
    - *RESP* as *TYPE*,
    - *GAIN* as *1.0*,
    - *SWEEP* as *25MM/SEC* and size.

    The size might not be changeable on some waveforms. Select *Exit* and verify that a non symmetrical sine wave displays on the window.
13. Set the Dynatech MED SIM300 to a heart rate of 300BPM. Verify that the ECG HR reads *300BPM ±1BPM*.
14. Turn off the simulator and verify that the message *ECG LOST* appears at the top of the window.
15. Turn the simulator back on and set the simulator for 60BPM, LEAD II and verify that the gain settings are effective at x.5, x2, and x4 for 1mv ECG input.
16. Select on the simulator for ECG performance. Cursor through the menu until you obtain and execute twice the *PACED RYTHMS*. Verify that PACE is turned on in the menu screen of the 8100. You should see white spikes on the waveform and 75BPM.
17. Select **ECG** on the simulator, select **base**, then **BPM**, and **60**. This gives a normal sinus rhythm at this time. Select **ECG**, then **ARRH**, then **VNT2**, and then **VFIB**. The unit should detect an erratic baseline and display the message *ECG LOST*.

ECG Analog Output Test

You need a MedSim 300 patient simulator to perform this procedure.

1. Connect a BNC cable with 0.1uf CAP signal-to-ground from the ECG BNC on the monitor to an input channel on an oscilloscope.
2. Select and press the *PARAMS* softkey.
3. Set *Filter* to *Diagnostic* and *ECG Sensitivity* to *Medium*.
4. Select and press the *DISPLAY* softkey.
5. Set *Waveform 1* for ECG Lead II (*ECG II*) on the screen.
6. Set the MedSim 300 patient simulator for “Sq. 2HZ.”
7. Verify that the baseline is zero and signal is a peak-to-peak voltage of 1.2V (±0.2).

Diagnostic, Monitor, and ST Filter Modes Test

1. Test the *DIAGNOSTIC*, *MONITOR*, and *ESU FILTER* modes.
2. In the *PARAMS* window, set *Filter* to *Diagnostic*. On the simulator, select **PERF** under **ECG**, then **WAVE**, and then s40 (40 Hz sine wave). Verify that the sine wave signal displayed has amplitude no less than 0.95 X the input amplitude in mV when the simulator is set to **s10** (10 Hz sine wave). To accomplish this, measure the peak-to-peak amplitude of the 10 Hz sine wave in waveform Channel 2, then measure the peak-to-peak amplitude of the 40 Hz sine wave. There shall be no more than a 5% decrease (40 Hz amplitude = or > 0.95 X 10 Hz amplitude).
3. Select *Monitor* filtering. The 40 Hz sine wave shall be 0.70 X the input amplitude in mV when the simulator is set to **s10** (10 Hz sine wave). Measure as described in step 2.
4. Select *ST Filtering*. The 40 Hz sine wave shall be 0.70 X the input amplitude in mV when the simulator is set to **s10** (10 Hz sine wave). Measure as described in step 2. Set *Filter* back to *Diagnostic*.
5. On the simulator, use the **>** arrow to select **s0.05** for a 0.05 Hz sine wave. In the monitor's *DISPLAY* window, select a sweep speed of *12.5 mm/sec*. The 0.05 Hz sine wave shall be 0.70 X the input amplitude in mV when the simulator is set to **s10** (10 Hz sine wave). Measure as described in step 2.
6. Select *Monitor* filtering. The 0.05 Hz sine wave is no longer present (flat baseline). On the simulator, select **s0.5** (0.5 Hz sine wave) and verify that a 0.5 Hz sine wave with amplitude equal to 0.70 X the 10 Hz sine wave amplitude is present. Set the simulator back to **s0.05**.
7. Select *ST Filtering*. On the simulator, select **s0.05** (0.5 Hz sine wave) and verify that a 0.05 Hz sine wave with amplitude equal to 0.70 X the 10 Hz sine wave amplitude is present. Set *Filter* back to *Diagnostic*.

SpO_2 Verification

The following test requires a SmartSat SpO_2 analyzer. If you service the monitor (i.e., you open the housing), use the longer SpO_2 Performance test. For more information, refer to “DOX SpO2 Performance Testing” on page 6-3.

NOTE: For older revision SmartSat analyzers that do not have a Model 8100 selection, use the general Criticare selection in the SmartSat simulator. Check the SpO_2 value of 52% (±3%) with the analyzer set to 42%.

1. Verify that the message *SPO2: NO SENSOR* appears when there is nothing connected to the **SpO_2** connector.
2. Verify that the message *SPO2: HIGH AMBIENT* appears by introducing a higher than normal amount of ambient light on the SPO2 sensor detector. Verify the message disappears within 10 seconds after you remove the ambient light.
3. Verify that the message *SPO2: SENSOR* appears when you plug the finger sensor in, but without a finger actually inserted into the sensor.
4. Use an SpO_2 finger sensor and verify that the heart rate and plethysmograph operation display on the LEDs within 15 seconds. Verify that SpO_2 error messages do not appear (alarm violations can occur depending on individual readings and monitor set-up).
5. Verify the LCD displays a plethysmograph waveform. Connect cable CAT 931A to COM2. Plug BNC-A of the cable into a oscilloscope channel. In the *CONFIG* window, *ANALOG OUT SELECT*, select *PLETH*. Use the SpO_2 finger sensor to verify that the SpO_2 waveforms appear on the scope. The waveform should be centered on 0 volts and register 1 volt peak-to-peak. Remove the CAT 931A cable.
6. Verify that the pulse tone increases as you change the tone from *1* to *10* in the *Alarm Setting* window.
7. Use an optical load to simulate a small signal and verify that the message *SPO2: SEARCH or LOST* appears after search delay time ± 5 seconds. (An optical load that can be used for this test is a foam peanut used for packing.)

NIBP Verification

The NIBP verification requires Dynatech Nevada NIBP Analyzer. Connect the 8100 monitor to a Dynatech Nevada NIBP Analyzer set for the following operation.

NIBP Analyzer Settings
Adult 120/80 (90); Heart Rate 80 bpm
Neonate 80/50 (62); Heart Rate 80 bpm
Pressure Adjustments: Gain 100%; Shift 4

1. Use the T-connection with the dummy cuffs for these tests. Connect them to the 0-300 mmHg port of the NIBP analyzer.
2. Connect the monitor to an AC (mains) power source and turn on the monitor.
3. Press and hold down the monitor's NIBP CYCLE/STAT key. The monitor's cycle time window appears.
4. Select the *NIBP Cycle Time* to two minutes.

120/80 OPERATION SETTING

1. In the monitor's *ADM/DIS* window set the *Patient Size* to *Adult* mode.
2. Connect the NIBP hose to the fitting on the monitor.
3. Press the NIBP key.
4. Allow the monitor to take at least four (4) readings. Calculate the average of the four (4) readings and verify that each reading does not vary by more than ±4% or ±4mmHg (whichever is greater) from the calculated average. Each reading shall not vary more than 8 mmHg from the simulator setting.
5. Recalibrate the monitor if necessary.

80/50 OPERATION SETTING

1. Set the monitor to the *Neonate* mode.
2. To verify *STAT* mode operation, press and hold the NIBP CYCLE/STAT key.
3. Allow the monitor to take at least four (4) readings. Calculate the average of the 4 readings and verify that each reading does not vary by more than ±4% or ±4mmHg (whichever is greater) from the calculated average. Each reading shall not vary more than 8 mmHg from the simulator setting.

Temperature Verification

1. Select *Temperature ON* from the *PARAMS* window and *TEMP F/C: (Centigrade)*. Connect the temperature to **T1** on the unit. Insert the simulator (TP 400).
2. Verify that simulator settings correctly display for all temperatures that range from 20° C to 45° C with accuracy of ±0.1° C.
3. Select *Temperature ON* from the menu setup and *TEMP F/C: (Centigrade)*. Connect the temperature to **T2** on the unit. Insert the simulator (TP 700).
4. Verify that simulator settings correctly display for all temperatures that range from 20° C to 45° C with accuracy of ±0.1° C. Verify that *TEMP INVALID* appears when the temperature is at 0.
5. Verify that the message *TEMP INVALID* appears when the temperature is at 0 for both *TEMP 1* and *TEMP 2*.

Gas Flow CO_2/O_2 Verification

Turn on the monitor and then rotate the menu knob to select the *PARAMS* window. Select the unit of measure for *PERCENT*. Select *EXIT* to return to the *Main* menu where you select *CONFIG*, and press the menu knob. Rotate the menu knob to highlight *ENTER SERVICE MODE* and press the menu knob to select it. Rotate the menu knob to highlight *YES*. The password dialog box appears where you enter `PIA418`. After you enter the password the *Service* window appears where you select *CO2/O2* mode.

FLOW CALIBRATION

1. Connect a flow meter to the end of the sample line and measure the flow 150 ±10 milliliters. If not in that range, adjust by using the menu knob to select 150 ml/min flow and adjust for 150ml. Once stabilized, press the menu knob to accept any changes.
2. Select *50ml* and press the encoder knob and turn the encoder knob clockwise one click to activate the 50ml flow. Once stabilized, turn the encoder knob to adjust and then press the encoder knob to accept 50ml. Then change back to *150ml*.
3. Remove the sample line from the flow meter.
4. Power cycle the monitor.

OCCLUSION TEST

1. Connect a vacuum gauge (0-25 inches of mercury) to the sample line. There should be more than 12.5 inches of mercury of vacuum.
2. The message *CO2:OCCULSION* should appear. The pump should turn on.

EXHAUST TEST

1. Place the flow meter on the exhaust port and measure the flow. The flow should be more than 140 milliliters.

CO_2 TEST

1. Check the operation of the CO_2. Use 10% CO_2 gas. Simulate a breath rate between 10-20 BPM for 150ml/min flow and 5-10BPM for 50ml/min flow.

   The following parameters can be used with the Poet Plus 8100:

   - *READING (in MMHG)* = (% CO2 gas) X (barometric pressure in mmhg)
   - *READING (in %)* = (% CO2 gas--±0.4 for 10%; ±0.2 for 5%)

O_2 TEST

1. Attach 100% nitrogen to the sample line. The O_2 value should go to 1% or 0%. This indicates there are no leaks in the sample cell side of the pneumatics.

   NOTE: You must be in the *Service Mode* window to see this happen. The Service Mode password is `PIA418`.

2. Verify proper operation of the O_2. Use 10% CO_2, balance N_2 gas. Simulate a breath rate between 10-20BPM for 150ml/min flow and 5-10BPM for 50ml/min of flow. The unit should give a reading in 2-3 breaths. Accept if *INS O_2* is less than 3% and the *EXP* is between 19% and 23%.

IBP Verification

The main focus of the following steps is the MED SIM 300 (or its equivalent).

1. Attach the IBP cable from **BP1** on the simulator to **IBP 1** on the connector panel.
2. Select BP on the simulator. Select **Channel 1**. Select **STAT**. Select **ZERO** by using the up and down arrows on the MED SIM 300, scroll through the menu until *STAT* appears and press to select.
3. Rotate the rotary encoder knob to highlight *PARAMS* and move down to IBP1. Press the menu knob once. Set the *SITE* for *ART*.
4. Press the rotary encoder knob again. Adjust the *RANGE*. This should be set for *0-200*.
5. Exit out of *PARAMS*. Use the rotary encoder knob to scroll to select the *IBP1 ZERO* selection on the display. Observe that a *0* (zero) appears on the screen next to the line that contains *ART (---/---(---) MMHG*.
6. Return to the Medsim and select *WAVE* and execute. Select *ART* for *ARTERIAL* and press *EXE* to execute the function. Observe the waveform on the screen. Verify that the pressure reads 120/80 ±2MMHG.
7. Attach the IBP cable from **BP2** on the simulator to **IBP 2** on the connector panel.
8. Select BP on the simulator. Select **Channel 1**. Select **STAT**. Select **ZERO** by using the up and down arrows on the MED SIM 300, scroll through the menu until *STAT* appears and press to select.
9. Rotate the rotary encoder knob to highlight *PARAMS* and move down to IBP2. Press the menu knob once. Set the *SITE* for *CVP*. Press the rotary encoder knob again. Adjust the *RANGE*. This should be set for *0-20*. Press the rotary knob until you reach *IBP2* again. Exit out of *PARAMS*.
10. Exit out of *PARAMS*. Use the rotary encoder knob to scroll to select the *IBP1 ZERO* selection on the display. Observe that a *0* (zero) appears on the screen next to the line that contains *CVP (---) MMHG*.
11. Return to the Medsim and select *WAVE* and execute. Select *CVP* and press *EXE* to execute the function. Observe the waveform on the screen. Verify that the pressure reads 12 ±1MMHG.

Communication Testing

Perform the following tests of the output ports of the monitor.

Video Port

Use the external video cable and connect it to the **DB-15** port.

CRT monitor specification:

- IBM VGA compatible, (640 x 480);
- RGB color Analog monitor; 75 ohms impedance
- Vertical Sync Freq. must support 60 Hz ±5% and 85 Hz ±5%
- Horizontal Sync must support 31.5KHz to 45KHz
- 15 pin DB connector input;

1. Turn the monitor's power on. Select the *DISPLAY* softkey. When the *Display* menu appears, select *External Display* and select *ON*.
2. Verify that the port communicates to the external video display. The on-screen image of the vital signs monitor should match the external video display.

   NOTE: External video displays do not produce AMMI compliant waveforms graphics due to the variety of video aspect ratios.

COM2 Port Analog Port

1. To check the **COM2** port, configure the monitor for SpO_2 monitoring. Select and press the *CONFIG* softkey, scroll down to *Analog Out Select* on the *Config* menu, and select *ECG II*.
2. Connect a DIN-8-to-BNC cable (pn 90840A002) to the **COM2** port of the monitor. Attach the other end of the cable to an oscilloscope. In the *CONFIG* window, select *Analog Out Select* on the *Config* menu, and select *PLETH*.
3. Using an SpO_2 finger sensor, verify that the SpO_2 waveform appears on the scope.

BNC ECG Output

You need a MedSim 300 patient simulator to perform this procedure.

1. Connect a BNC cable with 0.1uf CAP signal-to-ground from the ECG BNC on the monitor to an input channel on an oscilloscope.
2. Select and press the *PARAMS* softkey.
3. Set *Filter* to *Diagnostic* and *ECG Sensitivity* to *Medium*.
4. Select and press the *DISPLAY* softkey.
5. Set *Waveform 1* for ECG Lead II (*ECG II*) on the screen.
6. Set the MedSim 300 patient simulator for “Sq. 2HZ.”
7. Verify that the baseline is zero and signal is a peak-to-peak voltage of 1.2V (±0.2).

Nurse Call

1. Connect the Smart Sat and monitor all the levels.
2. Insert the Nurse Call fixture into the back of the monitor while the Smart Sat simulator runs. The lights on the fixture should illuminate when any limit alarm s triggered.
3. Press the Alarm SILENCE key. Verify that the Nurse Call turns off.

Battery and Power Testing

This procedure provides a method of testing the power regulation and battery charging circuits of the main board. This test does not require you to open the monitor housing and break the warranty seal.

Equipment

The following test recommends using a battery dummy block. The dummy block is the same size as the battery used in the monitor and provides an extension to the battery contacts inside the battery cage.

⚠WARNING⚠

- Shock Hazard! Do not attempt to power the monitor with an external DC source, while sensors are attached to a person. Always use vital signs simulators when using alternate power sources during testing.

The dummy battery can be used with an external DC power source. Use BC precision Model 1646 or equivalent supply rated to 16 volts at 10 amps. Contact the CSI Service Department for more information.

The test also requires using a battery load simulator. The simulator is used with an ammeter to test charge current. For more details about battery load simulators for the monitor, contact the CSI Service Department.

Q-Current Procedure

1. Insert the battery dummy block and verify the quiescent current is less than 1mA in BATT1 (slot 1).
2. Verify that the on-current is less than 1100mA without the printer or NIBP pump running with an input voltage of 15VDC.
3. If CO_2/O_2 option is included, the current should be less than 1660ma with the CO_2 pump running and the heater turned on.
4. With AC (mains) plugged in, connect the battery load simulator to the main board at PS1, or a fake battery.

Bulk Charge Test

1. Switch the **Battery Select** switch to the **BATT1** position. Start with the simulated battery voltage at less than 10VDC. The ammeter should be 15ma ±6ma.
2. Slowly increase the voltage. Verify the bulk rate is 620ma ±100ma when the voltage is greater than 10VDC.
3. Continue to increase the simulator voltage up to **14VDC**. Verify that as the voltage is gradually increased over 14VDC, the current tapers down from 620ma.
4. Increase the simulator voltage up to **15VDC**. Verify the trickle charge rate of 15ma (±6ma). The actual voltage across the simulator should be about 13.5VDC.

5. Set the simulator voltage back to less than 10VDC.
6. Switch **Battery Select** switch to **BATT2** position. Start with the simulated battery voltage at less than 10VDC. The ammeter should be 15ma (±6ma).
7. Slowly increase the voltage. Verify the bulk rate is 620ma (±100ma) when the voltage is greater than 10VDC.
8. Continue to increase the simulator voltage up to 14VDC. Verify that as the voltage is gradually increased over 14VDC, the current tapers down from 620ma.
9. Increase the simulator voltage up to 15VDC.
10. Verify the trickle charge rate of 15ma (±6ma). The actual voltage across the simulator is about 13.5VDC. Set the simulator voltage back to less than 10VDC.
11. Remove the battery load simulator.

Test Both Batteries

1. Attach the test battery simulator into each of the slots on the power supply module. Connect both battery packs to the power supply. Set the power supply to 12.5VDC.
2. Turn on the monitor and verify that the two green battery icons are displayed on-screen.
3. Lower the voltage with the adjustment of the power supply to a voltage of 11.8VDC (±0.3VDC). Two yellow battery icons appear.
4. Lower the voltage to 11.5VDC (±0.3VDC) and verify that two black battery icons appear.
5. Continue to decrease the voltage and verify that the monitor shuts down @ 10.0VDC (±0.5VDC).

Test Single Battery

1. Attach the single test battery block into slot 1 of the power supply module. Attach the other end to a power supply with 12.5VDC. Turn on the monitor and verify that the green battery icon appears.
2. Lower the voltage with the adjustment of the power supply to a voltage of 12.2VDC (±0.3VDC). A yellow battery icon appears.
3. Lower the voltage to 11.9VDC (±0.3VDC) and verify that a black battery icon appears.
4. Continue to decrease the voltage and verify that the monitor shuts down @ 10.2VDC (±5VDC).
5. Attach the single test battery block into slot 2 of the power supply module. Remove the first test battery block. Attach the other end to a power supply with 12.5VDC. Turn on the monitor and verify that the green battery icon appears.
6. Lower the voltage with the adjustment of the power supply to a voltage of 12.2VDC (±0.3VDC). A yellow battery icon appears.
7. Lower the voltage to 11.9VDC (±0.3VDC) and verify that a black battery icon appears.
8. Continue to decrease the voltage and verify that the monitor shuts down between 10.2VDC (±5VDC).

Functional and Safety Testing Checklist

Functional and Safety Testing Checklist

Serial Number _____
Software Revision _____

Electrical Safety Testing		
Withstanding Voltage (Hipot)		
Hot/Neutral to Chassis Ground; 1mA @ 2600 VDC	Pass ___	Fail ___
Hot/Neutral to Secondary Ground; 1mA @ 5656 VDC	Pass ___	Fail ___
Hot/Neutral to ECG Isolated Ground; 1mA @ 6800 VDC	Pass ___	Fail ___
Hot/Neutral to IBP Ground; 1mA @ 6800 VDC	Pass ___	Fail ___
Hot/Neutral to Nurse Call Ground; 1mA @ 6800 VDC	Pass ___	Fail ___
ECG ISO Ground to Secondary Ground; 1mA @ 4242 VDC	Pass ___	Fail ___
ECG ISO Ground to Chassis Ground; 1mA @ 2600 VDC	Pass ___	Fail ___
Secondary Ground to Chassis Ground; 1mA @ 707 VDC	Pass ___	Fail ___
EPT to SpO_2 Ground; 1mA @ 2600 VDC	Pass ___	Fail ___
EPT to Temp1/Temp2 Ground; 1mA @ 2600 VDC	Pass ___	Fail ___
Electrical Leakage		
Case Leakage Ground Conductor		
Normal polarity (open ground) < 500 microamps	Pass ___	Fail ___
Reverse polarity (open ground) < 500 microamps	Pass ___	Fail ___
Normal polarity (open neutral & open ground) < 1 milliamp	Pass ___	Fail ___
Reverse polarity (open neutral & open ground) < 1 milliamp	Pass ___	Fail ___
ECG Mode to GND Normal (10 microamps)	Pass ___	Fail ___
ECG Mode to GND Reverse (10 microamps)	Pass ___	Fail ___
Leads all to Ground		
Normal polarity < 10 microamps	Pass ___	Fail ___
Reverse polarity < 10 microamps	Pass ___	Fail ___
Normal polarity (open neutral) < 10 microamps	Pass ___	Fail ___
Reverse polarity (open neutral) < 10 microamps	Pass ___	Fail ___
Leads to ISO position		
Normal polarity (ISO Test) < 50 microamps	Pass ___	Fail ___
Normal SpO_2 (ISO Test) < 50 microamps	Pass ___	Fail ___
Temp Cable		
Normal polarity (ISO Test) < 50 microamps	Pass ___	Fail ___
IBP Cable		
Normal polarity (ISO Test) < 50 microamps	Pass ___	Fail ___
Ground Continuity	Pass ___	Fail ___
Functional Testing		
Interface Inspection	Pass ___	Fail ___
Manual Controls Check	Pass ___	Fail ___
Alarm Verification		
Low Level Alarm	Pass ___	Fail ___
Medium Level Alarm	Pass ___	Fail ___
Alarm Off Indicator LED Flashes	Pass ___	Fail ___
Alarm Volume Control	Pass ___	Fail ___
Printer Check	Pass ___	Fail ___

Monitoring Module Verification

ECG Verification		
ECG Analog Output	Pass ___	Fail ___
Diagnostic, Monitor, and ST Filter Modes	Pass ___	Fail ___
SpO_2 Verification	Pass ___	Fail ___
NIBP Verification		
Check Adult Cuff at 120/80	Pass ___	Fail ___
Check Neonatal Cuff at 80/50	Pass ___	Fail ___
Temperature Verification	Pass ___	Fail ___
Gas Flow CO_2/O_2 Verification		
Flow Calibration	Pass ___	Fail ___
Occlusion Test	Pass ___	Fail ___
Exhaust Test	Pass ___	Fail ___
CO_2 Test	Pass ___	Fail ___
O_2 Test	Pass ___	Fail ___
IBP Calibration	Pass ___	Fail ___

Communication Testing

Video Port	Pass ___	Fail ___
COM2 Port	Pass ___	Fail ___
BNC ECG Output	Pass ___	Fail ___
Nurse Call	Pass ___	Fail ___

Battery and Power Test

Charger no-load output (13.6 VAC ±5%)	Pass ___	Fail ___
AC power LED	Pass ___	Fail ___
Battery power operation	Pass ___	Fail ___

CERTIFICATION OF FUNCTIONAL AND SAFTEY TESTING

TECHNICIAN _____DATE_____

This checklist may be copied as needed to record field testing

Section 6 — Service Testing and Calibration

Field Service Testing Safety

⚠WARNING⚠

- Service testing procedures require working with exposed electrical circuits and should only be attempted by experienced electrical or biomedical technicians.
- When a monitor is altered through repair or hardware adjustment, it should be fully tested before use.

⚠CAUTION⚠

- Always follow ESD precautions when performing any procedure discussed in this section.
- The manufacturer recommends that a serviced monitor be allowed to run for 24 hours before the monitor is placed back into operation.
- Modules and PCBs that have been repaired may require more extensive testing than what is described in this manual.

The pre-assembly testing of printed circuit boards (PCBs) is not covered in this manual. Disassembly of surface mounted components on PCBs is not recommended. Tests provided here are only for the identification of damaged or degraded PCBs.

Field Service Test Matrix

Any time you open a monitor's case you must perform electrical safety tests before you return the monitor to operation. If you service the monitor, you should also perform the functional tests.

You should perform additional tests that are specific to modules and assemblies when you service, adjust, calibrate, or disassemble assemblies. See the following table.

Field Calibration Procedures

Some of the following procedures require specialized equipment that could be available only to larger service facilities.

Calibration kits are provided for field calibration of the CO_2/O_2 module. The field gas calibration is not intended to replace factory calibration settings. Damaged or otherwise faulty CO_2/O_2 modules could require factory calibration that can only be performed at Criticare Systems.

Criticare recommends that gas calibration, NIBP calibration, and calibration of the ECG/Analog Board be performed at CSI authorized service facilities.

Field Service Testing ● Required Test ✔ Recommended Test	Withstanding Voltage (Hipot)	Electrical Leakage	Ground Continuity Test	Functional Testing	ECG Verification	SPO_2 Verification	NIBP Verification	Temperature Verification	Gas Flow/CO_2/O_2 Verification	IBP Verification	Communication Testing	SpO2 Performance Test	NIBP Module Calibration	Temperature Check	Gas Calibration	IBP Calibration	Main Board Testing
No Fault (case opened)	✔	●	✔	✔											●		
NIBP Pump	✔	●	✔	✔			●						●				
SPO2 Board	✔	●	✔	✔		●						●					
ECG/Analog Board	✔	●	✔	✔	●	✔		●				●					
Gas-Pneumatics/Pump	✔	●	✔	✔					●						●		
O2 Cell									●								
CO2 Absorber									●								
Main Board	✔	●	✔	●	●	●	●	✔	✔	●	●		●				●
Display/Inverter Board	✔	●	✔	●													
IBP Board										●						●	
Key Pad	✔	●	✔	●	✔	✔	✔	✔	✔	✔	✔						
Printer and/or Board	✔	●	✔	✔													
Power Module	✔	●	✔	●	✔	✔	✔	✔	✔	✔	✔						
Instrument Dropped	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔						
Software Download				●	✔	✔	✔	✔	✔	✔	✔						
Annual Safety Test	✔	●	✔	✔	✔	✔	✔	✔	✔								

DOX SpO_2 Performance Testing

This test requires a SmartSat Pulse Oximetry Analyzer, Model SS-100A. The SmartSat is a programmable simulator and probe analyzer. The SmartSat is the recommended device for testing the DOX SpO_2 module. The SmartSat, model SS-100A, is available from Clinical Dynamics Corp. of Wallingford, CT.

The SmartSat comes standard with a Lemo style connections. The Cat. No. 913A adapter that converts Lemo to DB-9 style SpO_2 connections is needed for the 8100 series. The analyzer also has a custom port designed for testing DOX™ SpO_2 sensors.

Programming the SmartSat Analyzer

The SmartSat can be used for spot checking SpO_2 values using the manual settings. The manufacturer recommends using a timed and programmed sequence to ensure that there is optimal performance.

For older revisions of SmartSat Analyzer that does not have a program for the Model 8100 monitor, program the SmartSat as specified below. Verify that the monitor's display value matches the corresponding value in the test procedure, not the program settings.

AUTO SEQ: MODEL 8100			Oximeter	DOX
Step	**Time**	**Mod**	**Setting**	**Rate**
1	18s	5.00	99	40
2	20s	5.00	96	60
3	20s	5.00	89	80
4	20s	5.00	73	100
5	20s	5.00	52	120
6	20s	5.00	42	180
7	20s	5.00	26	300
8	END			

Recent versions of the SmartSat Analyzer are pre-loaded with a different program, but utilize the same test.

Test Procedure

1. Verify the SpO_2 module. (For verification, refer to “SpO2 Verification” on page 5-26.)
2. Attach the monitor to the SmartSat.
3. Start the SmartSat programmed sequence: *SmartSat Auto Sequence*. Verify that the monitor’s reported SpO_2 values are within the limits specified.

Level	Saturation(%)	Limits(%)	Heart Rate	Limits
1	99	97 - 99	40 bpm	39-41 bpm
2	96	94 - 98	60 bpm	59-61 bpm
3	90	88 - 92	80 bpm	79-81 bpm
4	78	76 - 80	100 bpm	99-101 bpm
5	61	58 - 64	120 bpm	119-121 bpm
6	52	49 - 55	180 bpm	179-181 bpm
7	40	37 - 43	190 bpm	297-191 bpm

4. Even if the monitor fails only one level, rerun the sequence after 30 seconds. Only if the monitor is successful the second time, do you pass the monitor.
5. If the monitor fails again, contact the CSI service department.

SpO_2 Board Test Values

While the DOX SpO_2 Board is in operation, it should conform with the following test values. The operational current draw of the board should be less than 50 ma. Use TP4 as ground for each measurement.

Test Point	Signal	Value
TP3	-5A	-5V (±0.05V)
C9(+)	+10	+10V (±0.20V)
TP2	+5D	5V (±0.05V)
VR1 (4)	-2.5VREF	-2.5V (±0.03V)

1. If the any of these values fail to test correctly, isolate the problem to either the SpO_2 Board or the power supply circuits.
2. Remove the SpO_2 Board from the monitor.
3. Test the equivalent signals on the ECG/Analog Board circuits, -5A, +10, +5D, -2.5VREF. See “Assembly Tests” on page 7-40.
4. If the values return to normal with the SpO_2 Board removed, replace the SpO_2 Board. For more information see procedure 91342T002.

NOTE: The ECG/Analog Board provides power to the SpO_2 Board.

The DOX SpO_2 Board can be replaced as a serviceable component. The downloadable software settings associated with the SpO_2 module are stored on the ECG/Analog Board. No calibration or SpO_2 Board preparation is required.

NIBP Calibration

Equipment Required:

- CAT #1320 kit, which includes:
- PC computer configured for use with CSI Service Software

(Install the service software according to the procedure that comes with it.)

- 8100 serial download cable
- 700cc dummy cuff
- ESD protected workbench
- Digital reference manometer
- Dynatech Nevada NIBP Analyzer

1. Connect a serial download cable from the PC serial port to "COM2" (J10 on the Main Board). Set the DIN download cable to NIBP/USER.

2. Open the service tool on the computer. Select *Start > Programs > CSI NIBP Service > NIBPSvc*. Close the disclaimer dialogue box.
3. Click on *Connection* and select *Options*.
4. Select *COM1* for the port and select *Poet Plus 8100* for the model. Click on *OK*.
5. Click on *Connection* and select *Open in Service Mode*.
6. Press the Poet Plus 8100 monitor ON/OFF key to start the monitor.
7. Connect a 700cc dummy cuff and manometer to the NIBP fitting on the unit.
8. On the LCD window of the monitor verify that the message *NBP SERVICE TOOL* and the pressure reading appears.
9. Verify that the monitor's serial number appears on the ID box. Click *OK*.

10. Click on the *Calibrate* button to calibrate the NIBP module.

11. Check the cuff pressure as indicated on the service screen of the computer. The cuff pressure should be zero ±1 mmHg. If the zero base point is out of range, the NIBP module must be calibrated.

    If the zero base point is out of range, manually set the NIBP module.

    If the zero base point is within ±1 mmHg of zero, proceed to the next step. (In this case, you skip the instructions which are found in the topic **Manual Zero Point Calibration**.)

Manual Zero Point Calibration

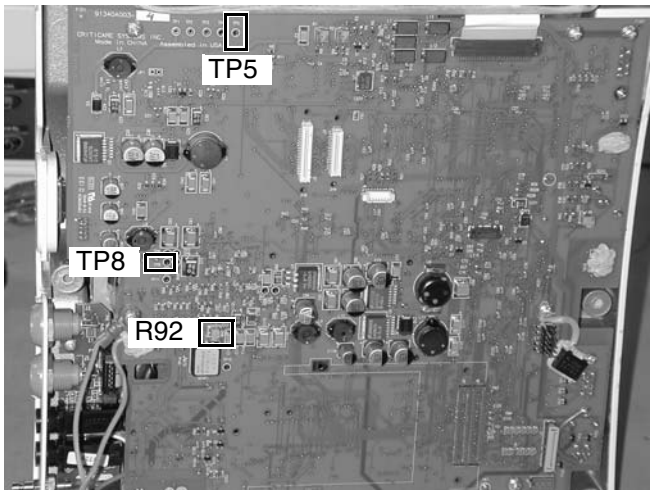
⚠CAUTION⚠

- Utilize ESD protections at all times.
  a. Open the case of the monitor to expose the Main Board. Follow the disassembly procedures in “Disassembly” in Section 7 of this manual. The Main Board can remain attached to the rear assembly.

  b. Allow the monitor to remain on. You can label and remove the screen power and data cables to gain access to the Main Board. You can label and disconnect interior gas sample lines as the case is pulled open.

  c. Check TP8 for a value of 0.122VDC (±0.002VDC). Use TP5 as ground.

  d. Adjust pot R92 with a small plastic tuning tool until TP8 is 0.122VDC.



  e. Verify that the NIBP zero base point is 0 (±1) mmHg.

  f. Apply electrical varnish to seal the pot setting.

g. Re-attach the video screen cables and gas sample lines if you labeled and removed them.

h. Close the monitor. Since you opened the monitor case, you must safety test the monitor before you place the monitor back in service.

12. Select *NEXT* on the program. This sets the 0 mmHg level. Select *NEXT* again to actuate the pump and achieve the high pressure cal point.
The monitor automatically activates the pump after accepting the zero pressure.

13. Calibrate the high pressure point. Allow the pressure to stabilize (should be between 240 to 270 mmHg) before you make adjustments.

NOTE: The reference manometer must be able to have 0.01 resolution!

14. Adjust the *Cuff Pressure* measurement on the computer screen to match the measurement of the manometer. Press the **Up** and **Down** arrow keys of the computer keyboard to calibrate the reading on the PC screen. This should be within ±0.5 mmHg of the manometer reading.

15. Select *FINISH* to accept the high calibration point setting. This calibration gain setting is set electronically on the Main Board.

16. Turn the monitor's power off. This stores the calibration settings into non-volatile memory written to flash.

17. Exit the service program on the PC.

NIBP Performance

1. Restart the service program on the PC. Select *Start > Programs > CSI NIBP Service > NIBPSvc*. Close the disclaimer dialogue box.
2. Turn the monitor's power on again and establish a new communications link between the monitor and the PC service program.
3. To perform the service test for speed, click on the *Speed* button, then click on *Start*. When the unit passes the speed test, press *Done*.
4. To perform the service test for leakage, click on the *Leak* button, then click on *Start*. When the unit passes the leakage test, press *Done*.
5. To perform the service test for inflation safety, click on the *Safety* button, then click on *Start*. When the unit passes the safety test, press *Done*.
6. Turn the monitor off. Click on *Abort* if an error message appears on the computer once the monitor is off.

7. Exit the service program on the computer. Remove the download cable. Click *No* to exit the program; click *Yes* to save the data to a user-specified location.

Temperature Input Check

1. Connect the temperature simulator (TP400) to the one of the connectors; attach the cable to P3 of the ECG/Analog Board being tested.
2. Verify the Temperature on the display is within ±0.1 C for temperature simulator settings of 20, 25, 30, 35, 36, 37, 38, 39, 40, and 45C.
3. Disconnect the Temperature simulator from P3 and verify that the Temperature on the display is "---. -". Verify *TEMP INVALID* appears on the display.
4. Repeat steps 1-3 for the other connector on the temperature assembly.
5. Switch off the power to the Main Board. Disconnect all cables.

Gas Calibration

This manual provides a field calibration procedure for the gas module of the monitor. The equipment for calibration is available from CSI in the form of two kits that can be supplemented with a few common measuring devices.

Equipment required for calibrating the CO_2 module:

- Cal Kit, Cat. No. 612,
- Sample Line, 8 feet, Cat. No. 625,
- Replacement Water Trap, WaterChek Plus, Cat. No. 938,
- Barometer with unit of measure in mmHg, and
- Flowmeter with 50 ml/min and 150 ml/min capability.

Additional equipment required for oxygen calibration:

- 95% O_2, balance 5% CO_2, Cylinder, Cat. No. 716,
- Replacement Oxygen Sensor, O_2 Cell, Cat. No. 644,
- ESD grounding strap, required for O_2 cell replacement, and
- Phillips Screwdriver to remove access panel of O_2 cell.

NOTE: Follow the O_2 replacement procedure in “Oxygen Sensor Replacement” on page 5-9.

Calibration Kits

⚠CAUTION⚠

- Calibration kits contain compressed gas cylinders. Read and obey all precautions listed on the gas cylinder labels.

The Cat. No. 612 kit is for monitors with CO_2 only. The Cat. No. 715 kit provides an additional gas canister for calibrating the O_2 module. Items from the Cal Kits can be ordered separately.

CAT NO. 612
Supplied with this Cal Kit:

- 5% CO_2, balance N_2, Cylinder, Cat. No. 621
- 10% CO_2, balance N_2, Cylinder, Cat. No. 622
- Regulator, Cat. No. 623
- Regulator Tubing, Cat. No. 613

CAT NO. 715 (for monitors with oxygen monitoring)
Supplied with this Cal Kit:

- 5% CO_2, balance N_2, Cylinder, Cat. No. 621
- 10% CO_2, balance N2, Cylinder, Cat. No. 622
- 95% O2, balance 5% CO_2, Cylinder, Cat. No. 716
- Regulator, Cat. No. 623
- Regulator Tubing, Cat. No. 613

Before you Begin

Make sure the CO_2 and O_2 calibration gas cylinders are not depleted or near depleted, the pressure meter should be above zero, and you can hear a “hissing” sound when in use.

⚠WARNING⚠

- Never attach intravenous tubes to gas sampling connections because gas sampling lines could inadvertently be connected to intravascular fluid systems, thus allowing air into a blood vessel.

⚠CAUTION⚠

- Do not use if the CO_2 and/or O_2 calibration gas cylinder is beyond its expiration date.

CO_2 Flow Check

Perform a flow check at 150 ml/min and at 50ml/min. Perform the user calibration only if necessary. You should have the monitor on and open the *Service* window.

1. Rotate the rotary knob to highlight the *CONFIG* softkey. Press the rotary knob to open the *CONFIG* menu.
2. Rotate and press the rotary knob to select *Enter Service Mode*. *NO* is highlighted. Turn and press the rotary knob to select *YES*.
3. The *Enter Service Mode* window appears. Enter the service mode password (`PIA418`) to enter the service mode.
4. Rotate and press the rotary knob to select *Enter CO2/O2 Service*. *NO* is highlighted. Turn and press the rotary knob to select *YES.*
5. Rotate and press the rotary knob to select *150 ml/min Flow Rate*. The value *Turn to Incr/Decr, Press to Save* is highlighted. Rotate the rotary knob one click clockwise and one click counter-clockwise then press the rotary knob.

   NOTE: More than one click, clockwise or counter-clockwise, changes the flow setting. Verify the flow with a flow meter.
6. Use a flowmeter to measure the flow. The flow should be 150 (±2) ml/min. If the flow rate is not correct, turn the rotary knob clockwise to increase the flow (or counter-clockwise to decrease the flow). When the flow is within specification, press the rotary knob to save the setting.
7. Rotate and press the rotary knob to select *50 ml/min Flow Rate*. The value *Turn to Incr/Decr, Press to Save* is highlighted. Rotate the rotary knob one click clockwise and one click counter-clockwise then press the rotary knob.

   NOTE: More than one click, clockwise or counter-clockwise, changes the flow setting. Verify the flow with a flow meter.
8. Use a flowmeter to measure the flow. The flow should be 50 (±3) ml/min. If the flow rate is not correct, turn the rotary knob clockwise to increase the flow (or counter-clockwise to decrease the flow). When the flow is within specification, press the rotary knob to save the setting.

   NOTE: The low flow setting (50 ml/min) is not as stable as the high flow setting (150 ml/min).
9. Rotate the rotary knob to highlight *CO2 Zero Cal* and press to select. The value *Request CO2 Zero Cal* is highlighted. Press the rotary knob to select. The value *CO2 Zero Cal* is highlighted. Wait for zero calibration to complete.

CO_2 Verification

1. Connect a sample line (Cat. No. 625) and water trap (Cat. No. 938) to the monitor.

   Allow the monitor's power to remain on for at least one hour to warm up the monitor and stabilize the temperature.

2. From the *PARAMS* window select the CO_2 unit of measure. For greatest accuracy, use percent (%) CO_2 for the CO_2 unit of measure.
3. Confirm that *N_2O Compensation* is turned off.
4. Connect the bottle gas (either 10% or 5%).
5. From the *DISPLAY* window set a waveform *TYPE* to *ET CO2*. *EXIT* from the *DISPLAY* window. Verify that the CO_2 function displays.
6. Squirt gas from the bottle into the system. Verify that the parameter display box shows 10% (±0.4) or 5% (±0.2).

   NOTE: If the numbers do not meet the specifications, go to "CO2 User Calibration" on page 6-11 to calibrate the monitor for the correct values.

CO_2 User Calibration

Perform a user calibration at 150 ml/min and at 50ml/min. Perform the user calibration only if necessary. You should have the monitor on and open the *Service* window.

1. Rotate the rotary knob to highlight the *CONFIG* softkey. Press the rotary knob to open the *CONFIG* menu.
2. Rotate and press the rotary knob to select *Enter Service Mode*. *NO* is highlighted. Turn and press the rotary knob to select *YES*.
3. The *Enter Service Mode* window appears. Enter the service mode password (`PIA418`) to enter the service mode.
4. Rotate and press the rotary knob to select *Enter CO2/O2 Service*. *NO* is highlighted. Turn and press the rotary knob to select *YES.* Verify that the *CO2 Operating Mode* is in *User Mode*. The display shows a 10% CO_2 reading.
5. Connect 10% CO_2 calibration gas (Cat. No. 622) to the monitor sample line. Calculate the ideal reading for 10% CO_2.
6. Rotate the rotary knob to highlight *CO2 Operating Mode*. Verify that *User Mode* highlights. If not, press and rotate the rotary knob to *User Mode* and the press the rotary knob. The 10% CO2 reading displays.
7. Rotate the rotary knob to highlight *CO2 Gain Adjustment* and press to select. Turn the rotary knob clockwise to increase the CO2 reading or counter-clockwise to decrease the reading. Adjust for a CO_2 reading of 9.7% to 10.1%. Press the rotary knob to save the gain.

8. Once you have adjusted the CO_2, press the rotary knob then turn the rotary knob until until *CO2 Zero Cal* is highlighted. Press the rotary knob and select *Abort CO2 Zero Cal*.
9. Press the knob, then turn the rotary knob one click counter-clockwise to select *Request CO2 Zero Cal* and press the rotary knob again.

   NOTE: After the first zero cal request you must first abort before you request a zero cal. Every time you make an adjustment, you must request a zero cal.
10. Once you finish the zero cal, turn the rotary knob until *50ml/min Flow Rate* is highlighted. Press the rotary encoder, turn the rotary knob one click counter-clockwise, and press the rotary knob again. The monitor is now in the 50ml range.
11. Repeat steps 7 through 10 for the 50ml flow rate.
12. Adjust for 10%. Request a zero cal if you are satisfied with the number after the zero cal. Go back to the 150ml flow and flip back and forth between the two flows. If no adjustment is needed, you are ready to exit the service screen. Return the flow to 150ml when you are ready to exit the service screen. Verify that nothing is highlighted, then power cycle the monitor off and on.

O_2 Calibration

NOTE: To respirate, turn the regulator valve on and off simultaneously while you perform this procedure.

1. Connect the Poet Plus 8100 monitor to the Respiration circuit box, if it is not already connected.
2. Connect the 10% CO_2 to a sample line on the unit.
3. Turn the rotary knob to select the *CONFIG* menu, then turn the rotary knob until *Enter Service Mode* is highlighted. Press the rotary knob and select *YES*.
4. Enter the password (`PIA418`) then press the rotary knob. Turn the rotary knob to select *Enter CO2/O2 Service*. Press the rotary knob and select *YES*. The CO_2 and O_2 waveforms should display. The *CO2 Operating Mode* option should be set at *User Mode*.
5. Turn the rotary knob to select *O2 Wave Response, POT 1*. Press the rotary knob. Rotate the knob slowly clockwise while you observe the O_2 waveform. Watch the rising edge of the waveform. Adjust the knob until the rising edge just starts to overshoot. From that point, adjust the knob counter-clockwise until the rising edge no longer overshoots. The positive plateau of the waveform should be flat. Press the rotary knob to save the setting.

6. Turn the rotary knob to select *O2 Wave Response, POT 2*. Press the rotary knob. Rotate the knob slowly clockwise while you observe the O_2 waveform. Watch the falling edge of the waveform. Adjust the knob until the zero plateau is as flat as possible. Press the rotary knob to save the setting.
7. Turn the rotary knob to select *O2 / CO2 Wave Alignment*. Press the rotary knob. Rotate the knob one click counter-clockwise and then one click clockwise. One of the waveforms should invert and both waveforms should appear to be in phase.

   Observe the two numbers in the O_2 display column. The top number is the delay between the O_2 and CO_2 waveforms, in milliseconds. The bottom number is the confidence level that quantifies how much the waveforms are in sync. Adjust the rotary knob, one click at a time, while observing the delay and confidence level numbers. The delay changes by 0.5 ms and the confidence reading shifts. The confidence reading changes slightly from cycle to cycle, so observe the reading for several cycles. Adjust the rotary knob for the greatest confidence reading possible.

   Press the rotary knob to save the setting. The maximum confidence level should be greater than 9.0. If it is not possible to adjust to a reading greater than 9.0, the you should repair the unit.
8. Once you are satisfied with the results, then proceed to highlight the 50ML flow rate. If you are not, repeat until satisfied. Press the rotary knob, turn it one click counter clockwise and click the rotary knob again. You are now in the 50ml range.
9. Repeat steps 1 through 8. Once you are satisfied with the results, then proceed to highlight the 150ML flow rate. Press the encoder knob, click it onetime clockwise and click the encoder again. You are now in the 150ml range.
10. The 10% CO_2 and 95% O_2 readings display. Turn the rotary knob to select *CO2 Gain Adjustment* and press the rotary knob. Adjust the rotary knob clockwise to increase the CO_2 reading or counter-clockwise to decrease the CO_2 reading. Adjust for a CO_2 reading of 9.7% to 10.1%. Press the knob to save the gain.

    NOTE: If the waveform on O_2 looks abnormal, check the pressure from the O_2 tank. There should be only 100ml of flow coming out of the tanks.
11. Turn the rotary knob to select *O2 Gain Adjustment*. Press the rotary knob. Adjust the rotary knob for an O_2 reading of 95.0 (±2.0%). Press the rotary knob to save the setting.

12. Once you adjust the CO_2 and O_2, press the rotary knob, then turn the rotary knob until you highlight *CO2 Zero Cal*. Press the rotary knob and select *Abort CO2 Zero Cal*. Press the rotary knob, turn the rotary knob one click counter-clockwise to select *Request CO2 Zero Cal*, and press the rotary knob again.

    NOTE: After the first zero cal request you must first abort before you request a zero cal. Every time you make an adjustment, you must request a zero cal.

13. Once you are satisfied with both numbers after the zero cal, turn the rotary knob to highlight *50ml/min Flow Rate*. If you are not, repeat until satisfied. Press the rotary knob, click it onetime counter clockwise and click the rotary knob again. You are now in the 50ml range. Go back to Steps 12 to 14 and follow the same procedure for the 50ml flow.
14. Request a zero cal if you are satisfied with both numbers after zero cal, then go back to the 150ml flow. Now flip back and forth between the two flows. If no adjustment is needed, you are ready to leave the service screen. The flow should be back on the 150ml when you are ready to leave. Verify that nothing is highlighted, then power cycle the monitor off and on.
15. Keep respirating the gas into the unit. Observe the inspired O_2 reading. The reading should be 21.0 (±2.0%).
16. Verify that in normal operation the 5% and 95% read correctly on the 150ml flow.
17. Verify that in normal operation the 5% and 95% read correctly on the 50ml flow.
18. If these numbers are satisfactory for you then proceed to the cal check. Return to 150ML of flow

Flow Rate Verification and Calibration

Follow the procedure found in “Gas Flow CO2/O2 Verification” on page 5-28.

IBP Calibration

You must perform the IBP factory calibration procedure in the Service Mode. The Service Mode password is PIA418.

You need a Fogg BP-600 Pressure Transducer Simulator to perform this calibration.

The main focus of the following steps is the monitor with the power turned ON.

1. In the monitor's *CONFIG* window, select *Enter Service Mode*, and then select *Yes*. Enter the correct password (PIA418) in the *Enter Service Mode* dialog box.
2. Verify that the software revision of the IBP Board appears on the screen.
3. Select *Enter IBP Service* and answer *Yes*. The IBP factory calibration window appears.
4. Verify current contents of the factory calibration (CAL) window as follows:

Select Channel Number:	1
Start or Restart Cal?	NO
Set 0 mmHg Point:	NO 0.0
Set 256 mmHg Point:	NO 838.8
Store CAL Results:	NO
Pressure Reported:	X, (where X is currently interpreted) input level (can be ±)

Current CAL Values in EEPROM:

	OFFSET:	GAIN:
IBP 1:	0.0	838.8
IBP 2:	0.0	838.8

NOTE: If a Main Board from a different unit has been used for the IBP calibration, the offset and gain numbers are different and the cal is stored on the Main Board chosen.

The main focus of the following steps is the BP-600 (or its equivalent).

5. Insert the BP-600 into the top IBP connector. Set the BP-600 to a pressure of 256MMHG and the switch set at the **ZERO** position. Select **Channel 1**.
6. For calibration, select *Start or Restart Cal?* and then select *Yes*.
7. Allow the pressure to stabilize before you select *YES* to the step below. Select *Set 0 mmHg Point* and then select *Yes*.

   NOTE: A set of corrective offset values appears at the end of the line. (Examples are -11 and -2.)

8. Set the simulator to 256 mmHg and the toggle switch to +. The *Pressure Reported* value changes to a positive integer that is close to the value of 256.
9. Select *Set 256 mmHg Point* and then select *Yes*. A corrective offset value appears at the end of the line. (An example is 852.8.) The *Pressure reported* value changes to *256*.

   NOTE: If the value at the end of the line is unchanged, then the calibration (CAL) failed. Restart calibration and begin at step 4.
10. Once the pressure has stabilized (256), to store your calibration select *Store CAL Results?* and then select *Yes*. Verify that the IBP 1 GAIN and offset values change to match the values from the set 0 and set 256 lines.
11. Insert the BP-600 into the bottom IBP connector. Set the BP-600 to a pressure of 256MMHG and the switch set to **ZERO**. Select **Channel 2**.
12. For calibration, select *Start or Restart Cal?* and then select *Yes*.
13. Allow the pressure to stabilize before you select *YES* to the step below. Select *Set 0 mmHg Point*, and then select *Yes*.

    NOTE: A set of corrective offset values appears at the end of the line (Example: -11. -2).
14. Set the simulator to **256 mmHg** and the toggle switch to +. The *Pressure Reported* value changes to a positive integer that is close to the value of 256.
15. Select *Set 256 mmHg Point* and then select *Yes*. A corrective offset value appears at the end of the line. (Example: 852.8) The *Pressure reported* value changes to *256*.

    NOTE: If the value at the end of the line is unchanged, then the calibration (CAL) failed. Restart calibration and begin at step 10.
16. Once the pressure has stabilized (256), to store the calibration, select *Store CAL Results?* and then select *Yes*. Verify that the IBP 1 GAIN and offset values change to match the values from the set 0 and set 256 lines.
17. Press the monitor's ON/OFF key to exit the *Service* window and turn off power to the monitor.
18. Press the ON/OFF key to turn on power to the monitor again. Attach the IBP cable from **BP1** of the simulator to **IBP 1** on the connector panel. Use the menu knob to select *PARMS* and then select *IBP1*. Press the menu knob once. Set the *SITE* to *ART*. Press the menu knob again. Adjust the *RANGE* to *0-200*. Press the menu knob again until you reach *ZERO*. Adjust the *ZERO* to *ALL*. Rotate the menu knob to highlight *ALL* and press to select. Observe that a *0* (zero) appears on the window next to the line that contains *ART (---/--- (---) MMHG*.

Monitor Fault Testing

The following procedures are used to determine whether boards and assemblies are damaged. New boards and mechanical assemblies should be tested as part of any replacement repair.

Board level tests require opening the monitor housing which can void your product warranty.

Always follow ESD precautions when performing these procedures.

⚠DANGER⚠

- High Voltage! Board testing requires working with dangerous voltages. The rear assembly, that contains the power supply module, should only be serviced by experience electrical technicians.

Power Supply Board Test

1. Remove the batteries from the monitor.
2. Open the case.
3. Follow the disassembly procedures (refer to “Disassembly” in Section 7 in this manual) to expose the power module. Do not remove the power module.
4. Disconnect the DC power cable at PS2 of the Main Board. Leave the other end attached to the Power Supply Board.
5. Using a controlled AC source, apply 115 VAC at 60 Hz to the AC receptacle. The source should be able to supply a minimum of 3 amps. (Use a power cable that has suitable connections to the AC source.)
6. Measure the DC power cable end. The power module should supply 15.6 VDC (±0.1V).
7. Proceed to the next step if the voltage is within specification. If it is a new board under test, it might not be calibrated. The trim potentiometer on calibrated boards should be varnished or otherwise sealed.
8. Remove the power module. Verify that the trim potentiometer measures 15.6 VDC.
9. Reassemble the monitor.

Main Board Testing

Test the following conditions without batteries in the monitor.

1. Connect a 16VDC 3A power supply to connector PS2 on the Main Board.
2. Insert an ammeter inline at PS1 on the Main Board.
3. Verify the quiescent current (the power is applied, but the power control is in the OFF state) is less than 1ma. This quiescent current decreases to less than 1ma in a very short period of time. This must be done at the Battery connector. Remove the ammeter.
4. Connect a speaker to J20 on the Main Board.
5. Connect a membrane switch to J7 on the Main Board.
6. Attach a menu knob to the main board at J8 on the Main Board.
7. Verify that the monitor turns on after pressing the ON/OFF key, and that the following voltages are present:

Test Point	Signal	Value	
TP21	+PWRUNSW	+16.0V	(±0.5VDC)
TP4	+5D	+5.0V	(±0.1VDC)
TP18	+5P	+5.0V	(±0.1VDC)
TP1	+3.3D	+3.3V	(±0.05VDC)
TP17	+8V	+8.0V	(±0.25VDC)
TP7	-5A	-5.0V	(±0.25VDC)
T13	+6.8	+6.8V	(±0.32VDC)
TP9	+5A	+5.0V	(±0.3VDC)
TP14	+5VREF	+5.0V	(±0.025VDC)
TP3	+5B	+5.0V	(±0.25VDC)

Section 7 — Disassembly

Before You Begin

1. Turn the monitor off.
2. Disconnect the A.C. (Mains) power cord and remove the batteries.

⚠WARNING⚠

- The procedures presented in this section are intended to be implemented by qualified biomedical engineering or field service personnel for PCB assembly replacement.
- The procedures presented in this section are not intended to be used for component-level trouble shooting and repair of the PCB assemblies. Only CSI service personnel are authorized to perform component-level repair.
- Possible safety hazard. Read the battery safety information provided in “Safety” on page 1-17

⚠CAUTION⚠

- Opening a monitor and breaking the quality seal can void your manufacturer warranty! Before breaking the seal on a CSI monitor, contact the CSI service department.

The repair procedures for the monitor are included here for the determination of damaged or unusable assemblies. CSI does not recommend attempting the field repair of the circuit boards.

This monitor requires the installation of a factory calibration lookup table in the CO_2 gas module. This lookup table is specific to the bench and gas module assembly. The factory calibration of the gas module cannot be performed by the user.

Service Safety

⚠DANGER⚠

- The monitor contains an internal AC power supply that contains potentially lethal voltages.
- High Voltage! The internal Power Supply Board has a protective shield that should not be removed during service. If the power supply is defective, replace the entire Power Supply assembly.

Electrostatic Discharge Protection

The procedures in this section require handling of electrostatic sensitive components. Microprocessors and other electronic components can be permanently damaged by attempting repairs at an unprotected workbench.

Use all electrostatic discharge (ESD) protection as described!

- Perform the disassembly procedure on an antistatic mat that is grounded. Check the ground cable to insure that it is connected to a good earth ground.
- Use a grounded soldering iron.
- Wear a wrist-grounding strap.
- Connect the wrist strap and mat through a resistor (1 megohm typical) to the same ground source.
- Test the wrist-ground straps on a daily basis.
- Temporarily store components in metal or antistatic containers. Do not store components in plastic dishes. Store circuit boards in sealed antistatic bags or cover them in antistatic boxes. Do not store electronic boards directly in cardboard boxes.

Front Housing Removal

Follow the ESD cautions discussed in “Electrostatic Discharge Protection” on page 7-2.

1. Remove the eight Phillips screws from the back of the unit as it sits on the table.

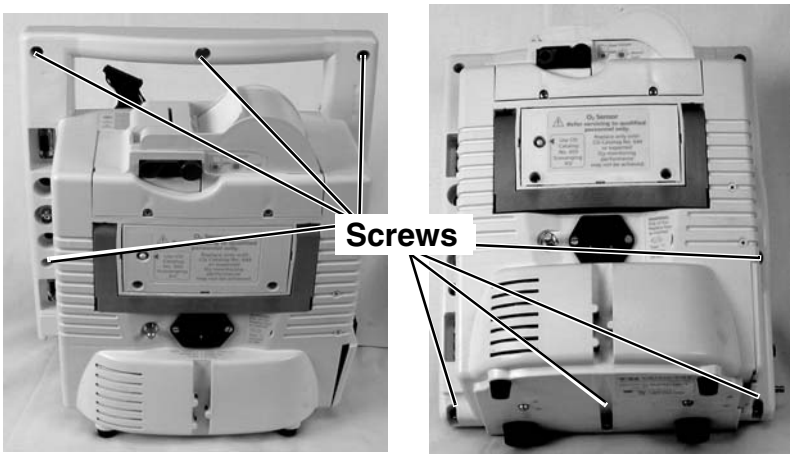


Figure 7-10: Screws on the Back of the Monitor

2. Carefully pull off the front housing in order to avoid pulling any wires.

   NOTE: The unit may be hard to open due to the curing of the adhesive on the water ingress shield. Carefully separate the housing taking care that you don't crack the housing.

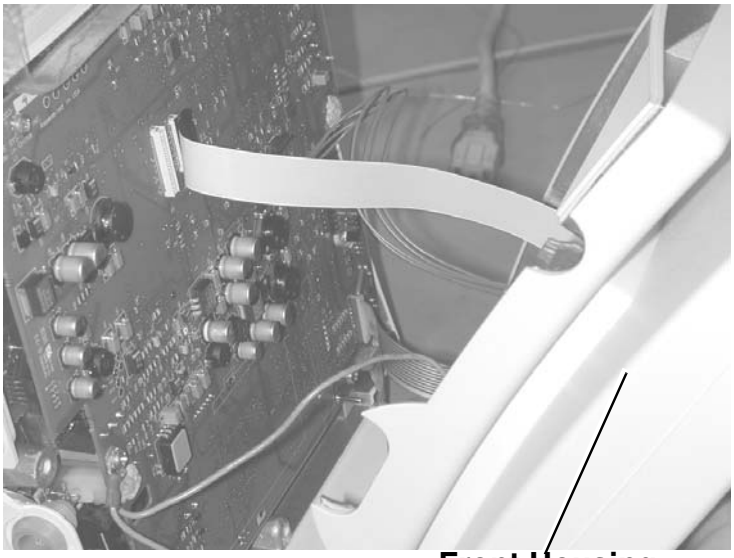


Figure 7-11: Remove the Front Housing

3. Label and disconnect the printer ribbon cable from J1 of the Main Board. See "Figure 7-11:Remove the Front Housing".
4. Label and disconnect the two display cables from J3 and J4 of the Main Board. See "Figure 7-11:Remove the Front Housing".
5. Note the orientation of the membrane cable in the ZIF connector. Unlock the ZIF connector. Label and remove the membrane cable from J7 of the Main Board. See "Figure 7-11:Remove the Front Housing".

6. Label and remove the menu knob cable from J8 of the Main Board. See "Figure 7-12:Main Board, Component Side".

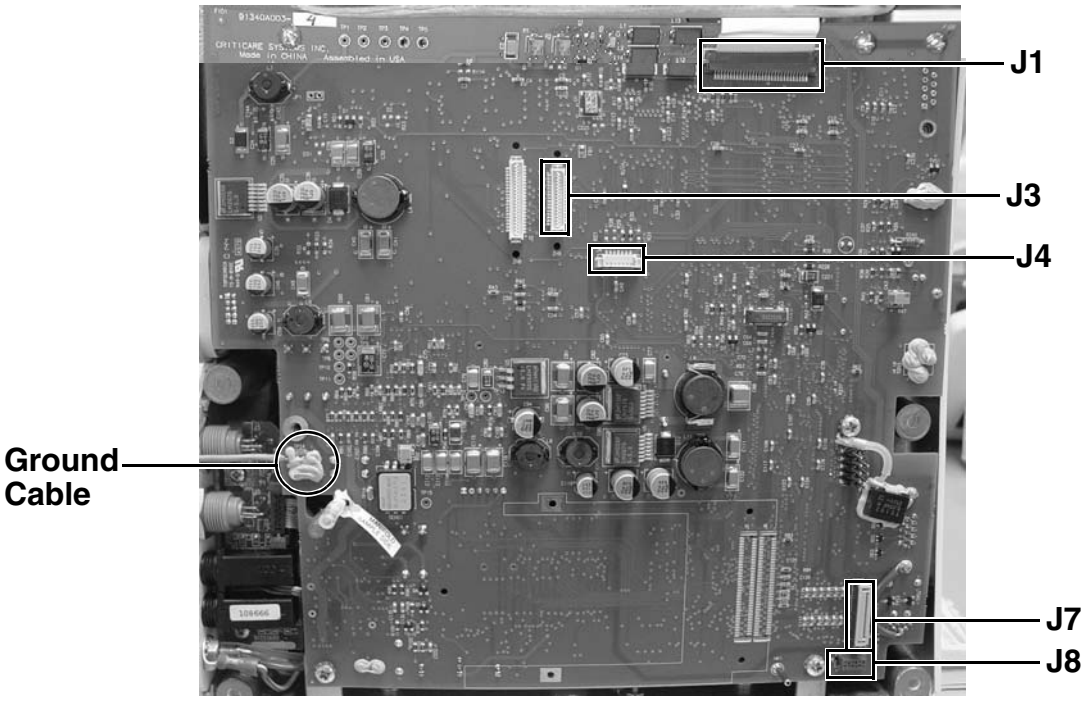


Figure 7-12: Main Board, Component Side

7. Disconnect the CO_2 tubing from the water trap manifold assembly.

   NOTE: Reconnect the Manifold Trap Side to the unit's left side port.

Figure 7-13: Disconnect the CO_2 Tubing

8. Lay the display front housing flat on the table.

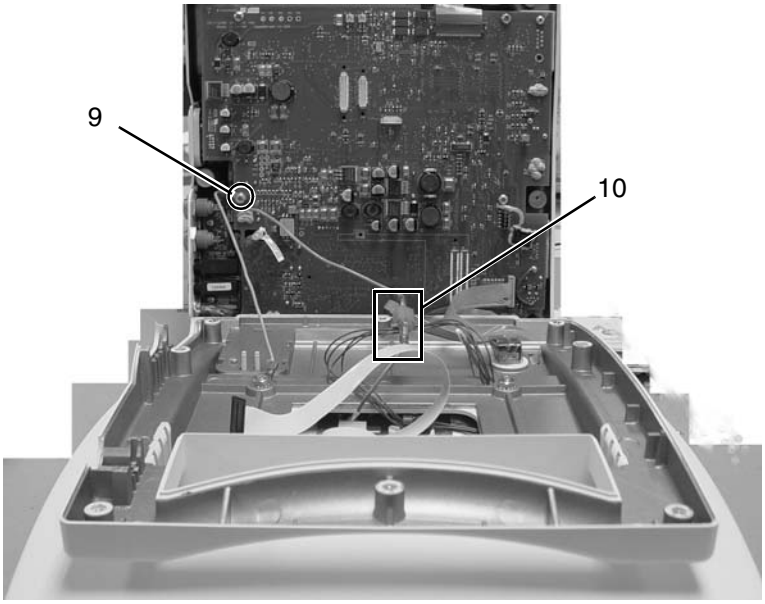


Figure 7-14: Lay Display Flat

9. Remove the ground cable Phillips screw which is held in place with a Phillips screw.
10. Remove the display ground cable by disconnecting it from the locking connector.
11. Remove the front housing assembly.

Front Housing Disassembly

The following procedure uses examples from a monitor with an 10.4-inch active TFT display.

Rotary Encoder Knob Removal/Replacement

1. With a flat screwdriver pry the rotary encoder knob from the unit.

Figure 7-15: Remove the Rotary Encoder Knob

2. Remove the retaining nut and lock washer from the front of the housing.
3. When you replace the rotary encoder knob, be sure to insulate with Kapton tape.
4. Reinstall and tighten the nut and lock washer.
5. Install the new rotary encoder knob.

Membrane Keypad Removal/Replacement

Use this procedure only if you need to replace the membrane keypad on the monitor.

NOTE: Once you remove a membrane from the front panel you cannot reattach it to the front panel.

1. With a flat screwdriver pry the rotary encoder knob from the unit.

Figure 7-16: Remove the Rotary Encoder Knob

2. Push a flat screwdriver through the ribbon cable slot to begin peeling the membrane off the front of the unit. Do not attempt to use tools to peel the membrane from the front as you may mar the case and be unable to properly attach the new membrane.

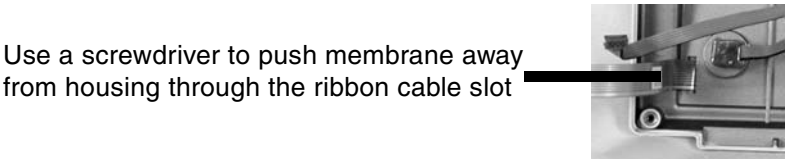


Figure 7-17: Removing Membrane

3. Peel the membrane away from the front housing.
4. Remove any excess glue from the front housing. Use a cotton cloth dampened with alcohol. If any glue remains on the housing, the new membrane cannot adhere properly.
5. Remove the protective backing from the adhesive on the new membrane.
6. Install the new membrane. Line up the membrane along a straight edge and lay the membrane into place. Press down firmly on the membrane when it is in position.
7. Reattach the rotary encoder knob to the front housing.

Water Trap Manifold Removal/Replacement

8. Remove the CO_2 cover from the manifold, located on the front of the unit.

Figure 7-18: Remove the CO_2 Cover

9. Remove the two Phillips screws from the back of the housing.

10. With a flat screwdriver release the two tabs to free the manifold and the water trap manifold cover.

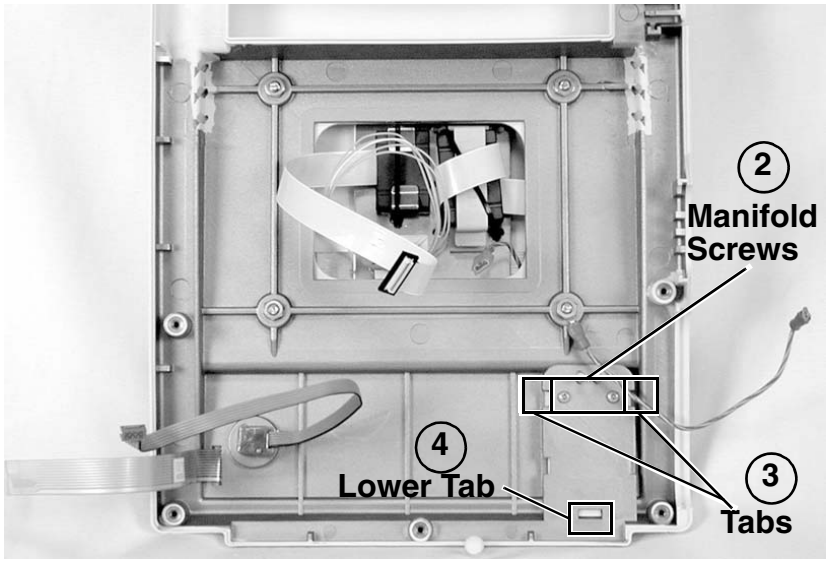


Figure 7-19: Remove the Water Trap Manifold

11. When you install the new manifold, be sure to insert the lower tab into the recess first.
12. Be sure the cover locks firmly in place.
13. Replace the two Phillips screws.

Display Assembly Removal/Replacement

1. Remove the four nuts from the interior frame of the front housing assembly. The front housing comes apart from the display.

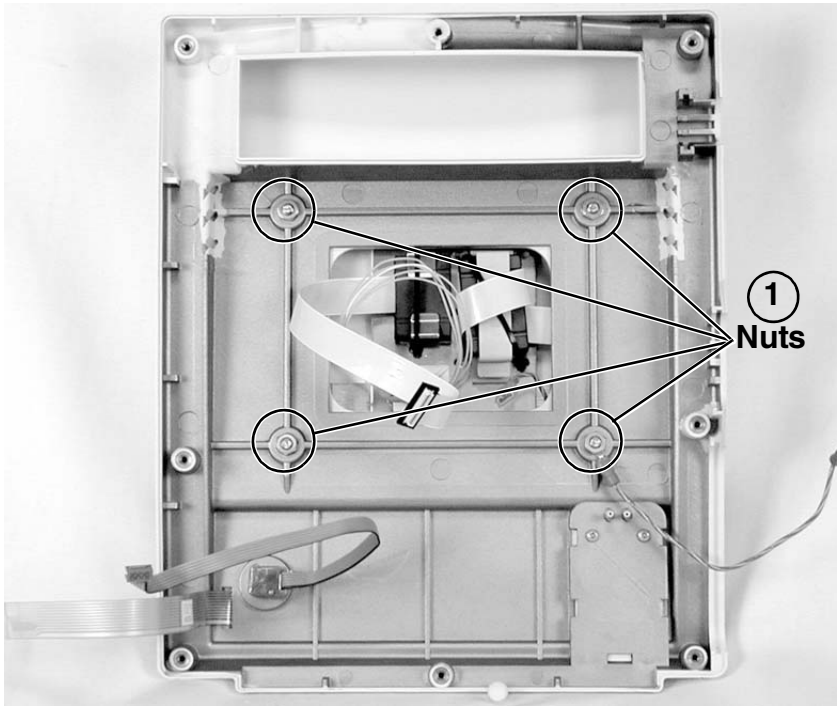


Figure 7-20: Remove the Display Nuts

2. Lift the front up. Allow the cables to slide through the access hole.
3. Remove the four screws that hold the display housing together.

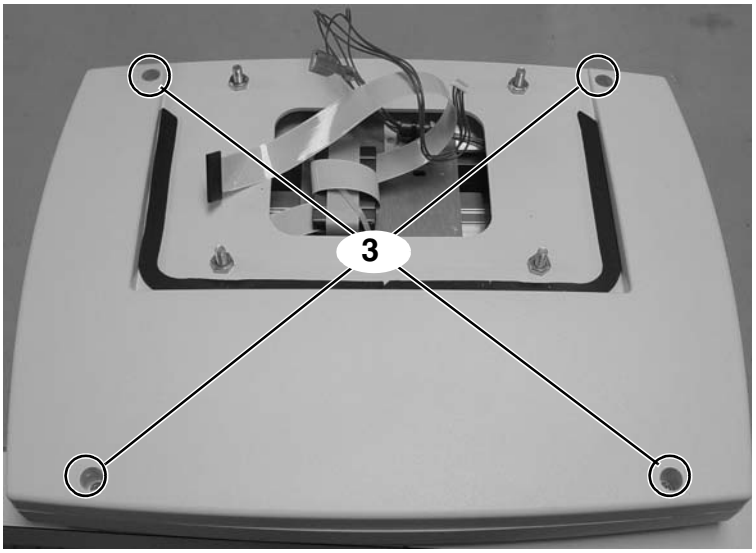


Figure 7-21: Remove the Display Housing Screws

4. Remove the back half of the display housing.

Inverter Board Removal/ Replacement

1. Label and disconnect the cables (Item 1 on the photo) on the Inverter Board.
2. Remove the two small Phillips screws and plastic washers.

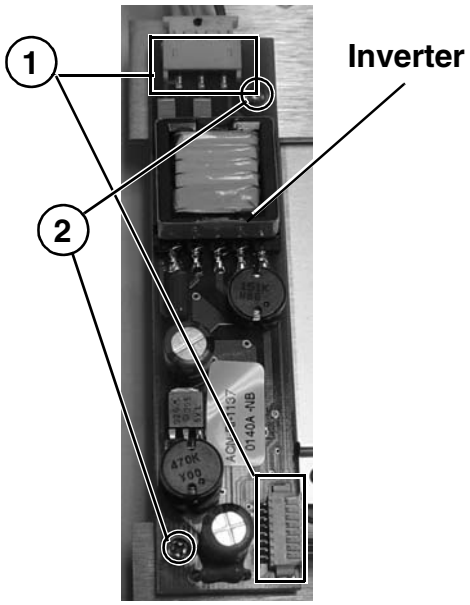


Figure 7-22: Remove the Inverter Board

3. Remove and replace the Inverter Board.
4. Fasten the Inverter Board with the two screws and nylon washers you removed earlier. (See #2 in "Figure 7-22:Remove the Inverter Board".)

   NOTE: When you install the new Inverter Board, be sure the nylon standoffs are in place.

5. Reattach the cables. (See #1 in "Figure 7-22:Remove the Inverter Board".)

Display Screen Removal/ Replacement

1. Remove the four Phillips screws.

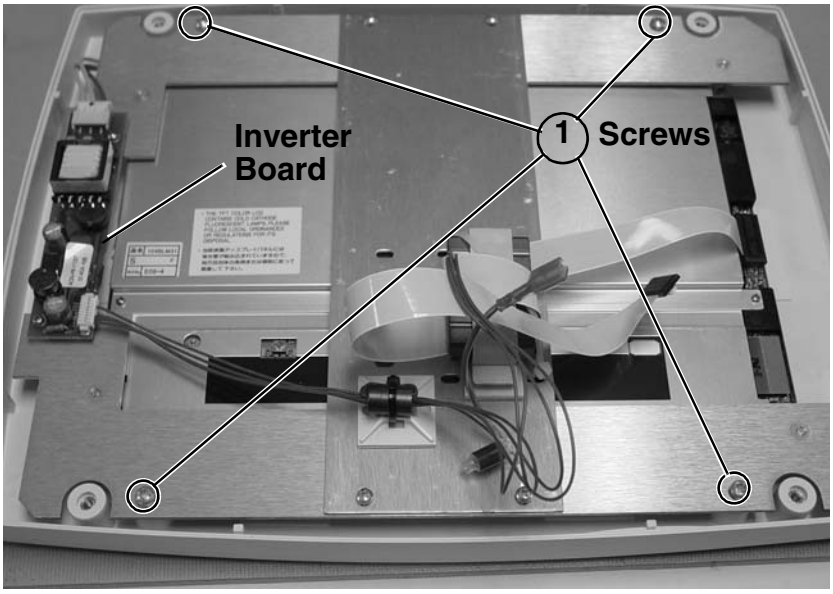


Figure 7-23: Remove the Display Housing Screws

2. Label and disconnect the cable at Label 2 from the Inverter Board.

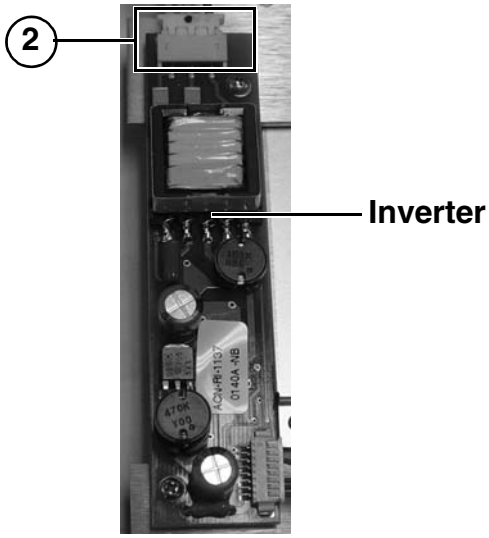


Figure 7-24: Remove the Inverter Board Connection

3. Disconnect the ribbon cable from the display.

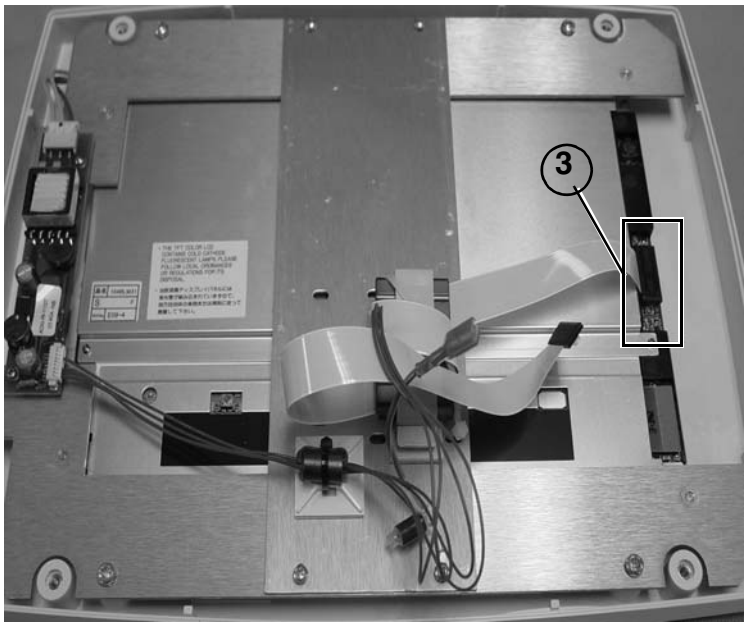


Figure 7-25: Remove the Ribbon Cable, Display Screws

4. Turn the display over and remove the four Phillips screws.

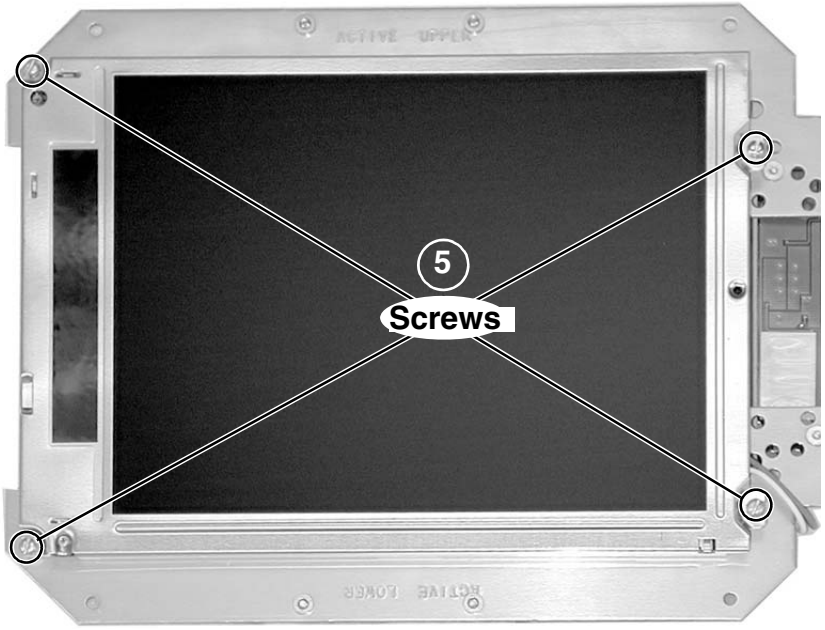


Figure 7-26: Remove the Display Screws

5. Remove and replace the display screen.

   NOTE: Be sure the display and the inside of the clear cover are clean before you re-assemble the assembly.

6. Reassemble in reverse order.

Printer Removal/ Replacement

1. Remove the paper roll from the unit.
2. Remove the two Phillips screws that hold the printer assembly.

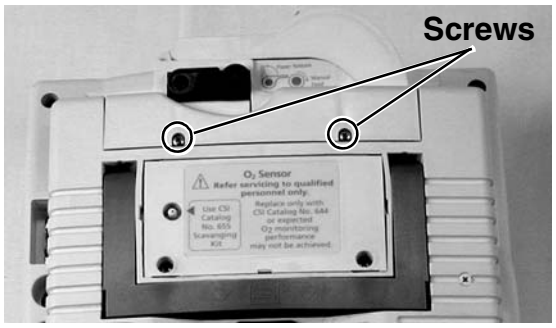


Figure 7-27: Remove the Printer Housing Screws

3. Disconnect the ribbon cable from CN1 on the the Printer Board.
4. Remove the printer assembly.
5. Replace the printer assembly and reassemble the monitor.
6. Remove the four Phillips screws from the Printer Board.

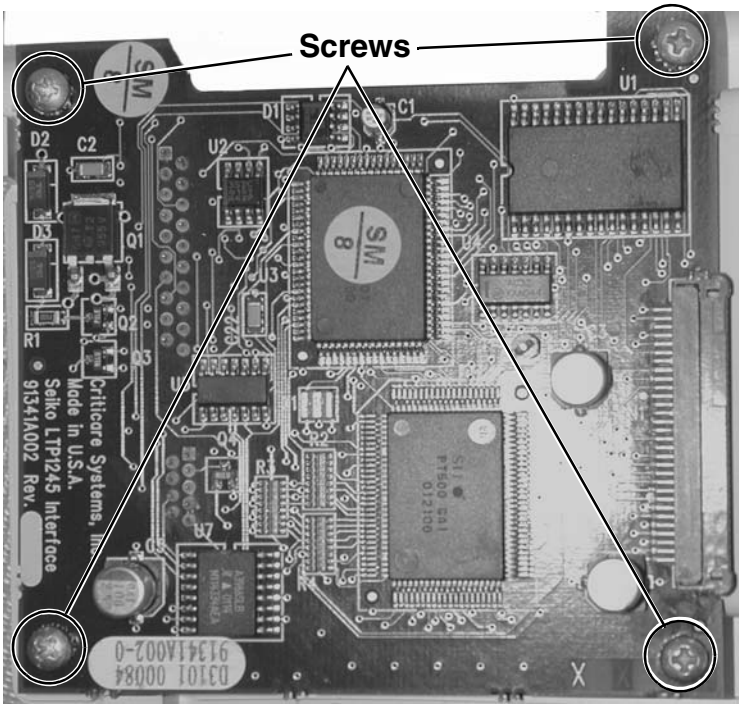


Figure 7-28: Printer Board Screws

7. Lift the Printer Board away from the unit.
8. Label and disconnect the cables from CN3 and CN2 on the back of the Printer Board.
9. Remove the metal plate and shielding.
10. Remove the printer from the housing.
11. Replace the printer and/or Printer Board and reassemble in reverse order.

Rear Housing Disassembly

Follow the ESD cautions discussed in “Electrostatic Discharge Protection” on page 7-2.

Because the interior of the rear assembly contains exposed AC contacts, you must disconnect the AC power before you begin the disassembly procedure. See “Before You Begin” on page 7-1.

Main Board Removal/ Replacement

1. Remove the front housing, as described in “Front Housing Removal” on page 7-2.
2. Remove the five Phillips screws shown in the picture below.

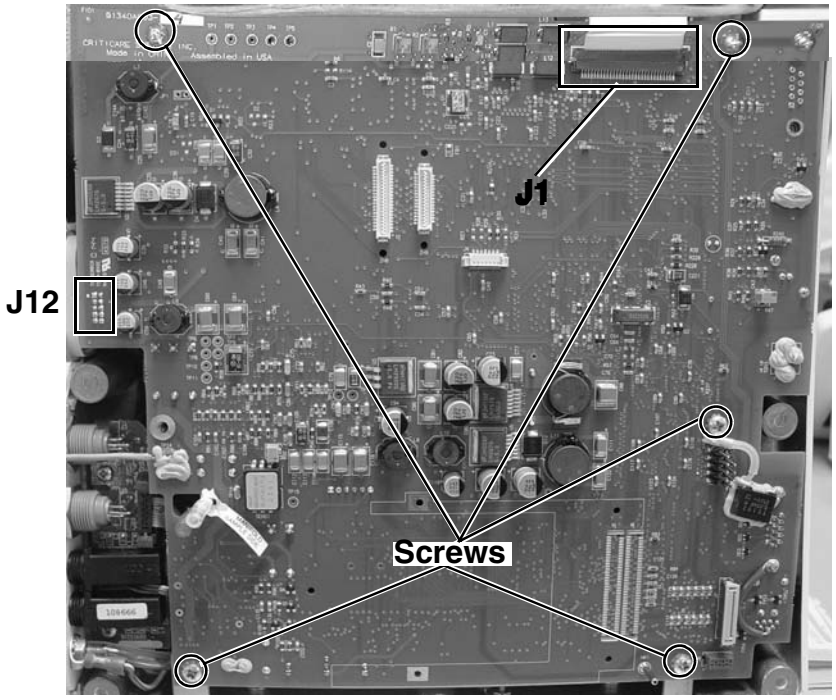


Figure 7-29: Main Board Screws

3. Disconnect the printer cable from J1 on the Main Board.

⚠CAUTION⚠

- The Main Board has a 10-pin connection (J12) directly into the ECG/Analog Board that is located behind it. Do not bend the pins when you remove the Main Board.

  NOTE: Make sure that you remove the black coverplates from the COM1 and the Video connectors.

4. Carefully pull the Main Board away from the front chassis. The board only pulls forward slightly.

   NOTE: P2, PS1, PS2, J14, J16, J18, J19, and J20 are on the solder (back) side of the Main Board.

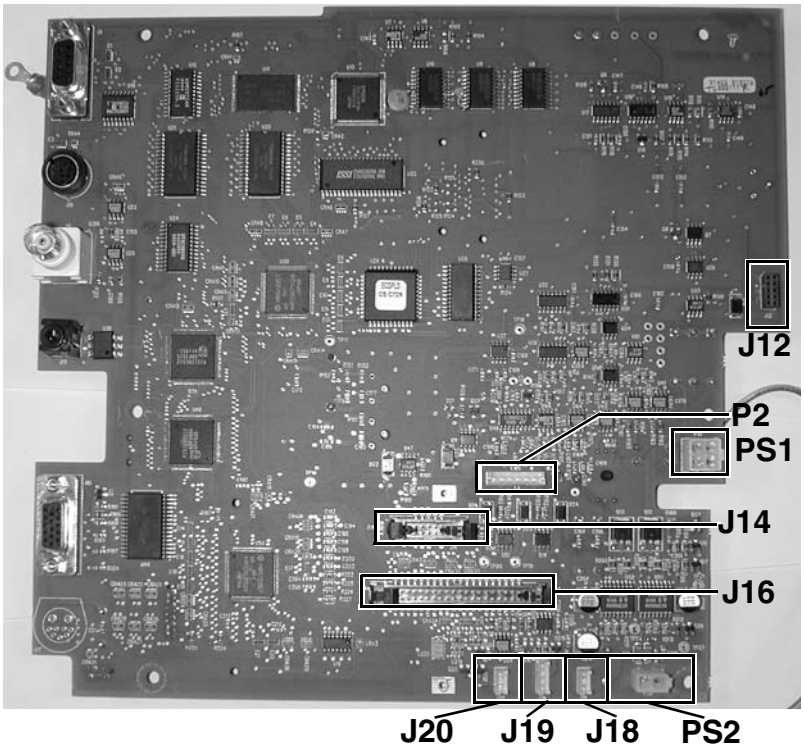


Figure 7-30: Main Board Solder Side Connections

5. Label and disconnect the battery power cable at PS1 on the Main Board.
6. Label and disconnect the Power Supply Board cable at PS2 on the Main Board.
7. Label and disconnect the IBP ribbon cable at J14 on the back of the Main Board.

   NOTE: This cable is only present if the monitor has the IBP option.

8. Label and disconnect the CO_2 ribbon cable at J16 on the back of the Main Board.

   NOTE: This cable is only present if the monitor has the CO_2/O_2 option.

9. Label and disconnect the NIBP Pump/Valve cable assembly at P2 on the Main Board.

10. Label and disconnect the thermister cable J18 on the Main Board.

    NOTE: J18 and J20 use similar connectors. Plugging these in the opposite connections results in a Main Board fault.

11. Label and disconnect the fan cable at J19 on the Main Board.

12. Label and disconnect the speaker cable at J20 on the Main Board.

    NOTE: J18 and J20 use similar connectors. Plugging these in the opposite connections results in a Main Board fault.

13. Remove the blue tygon tubing from SENS1 on the solder side of the Main Board. (SENS1 itself appears on the component side. The connection to SENS1 is on the solder side.)

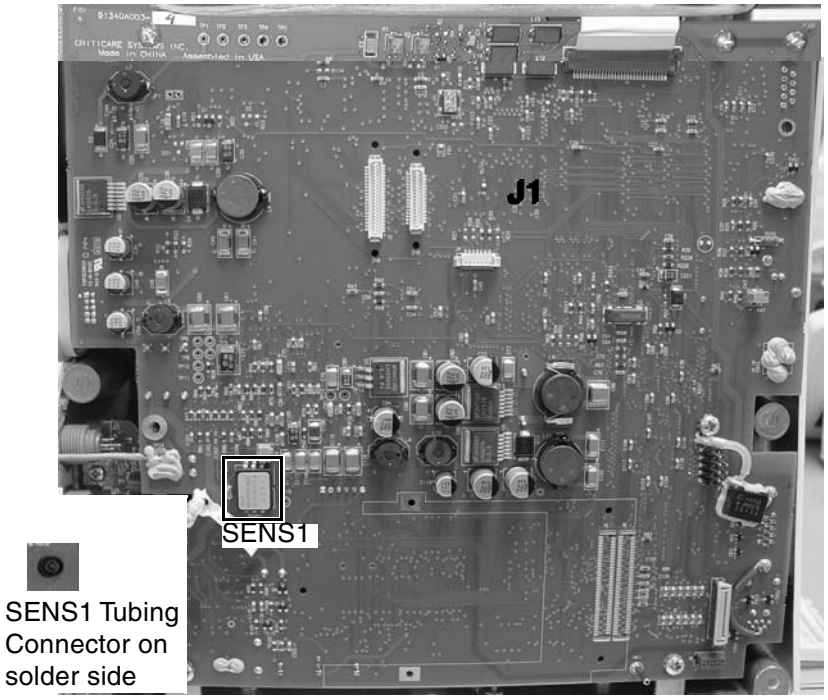


Figure 7-31: SENS1 Tubing

14. Replace in reverse order.

Connector Board Removal/ Replacement

To remove the Connector Board:

1. Remove the two Phillips screws holding the Connector Board to the unit.

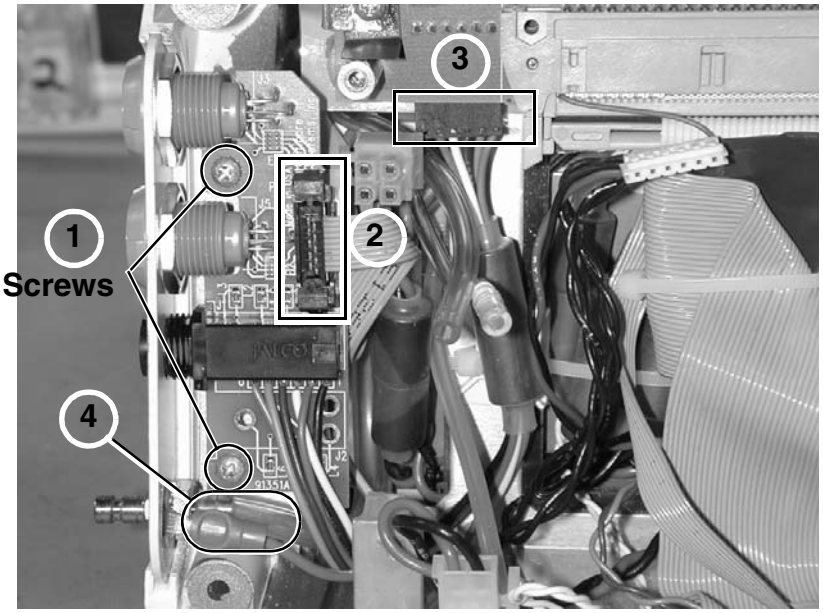


Figure 7-32: Remove the Connector Board Screws

2. On monitors with IBP, label and disconnect the ribbon cable at P1 on the Connector Board.
3. Label and disconnect the temperature cable from P3 on the ECG/Analog Board.
4. Disconnect the NIBP tubing from the NIBP fitting.
5. Remove the nut from the connector plate.
6. Replace the board assembly and reassemble in reverse order.

SpO_2 Cable/SpO_2 Board Removal/Replacement

1. Desolder the ground connection from the ECG/Analog Board (if not done already).

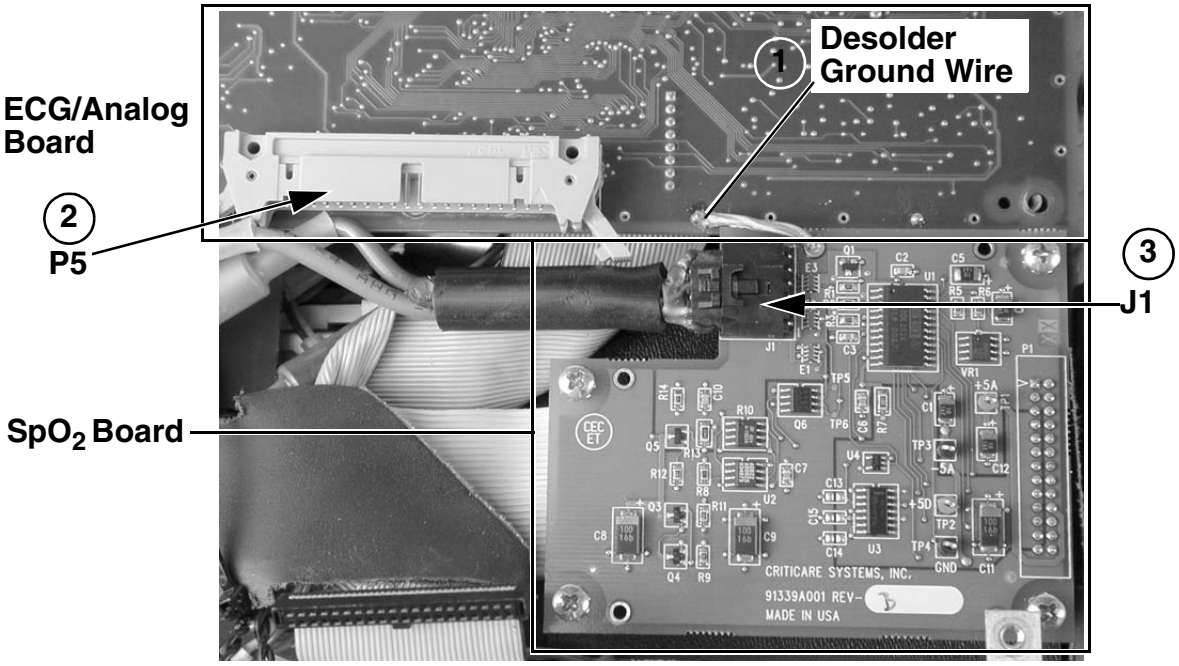


Figure 7-33: ECG/Analog and SpO_2 Boards

2. Detach the communication ribbon cable at P5 of the ECG/Analog Board.
3. Disconnect the SpO_2 cable from J1 of the SpO_2 Board.

   NOTE: If you must replace the SpO_2 cable, you must remove the ECG/Analog Board (see "ECG/Analog Board Removal/Replacement" on page 7-23). Then replace and reconnect to J1 of the SpO_2 Board.

4. *If necessary*, on monitors with CO_2, cut the cable tie on the P5 cable assembly.

5. Remove the four Phillips screws holding the SpO_2 Board to the chassis.

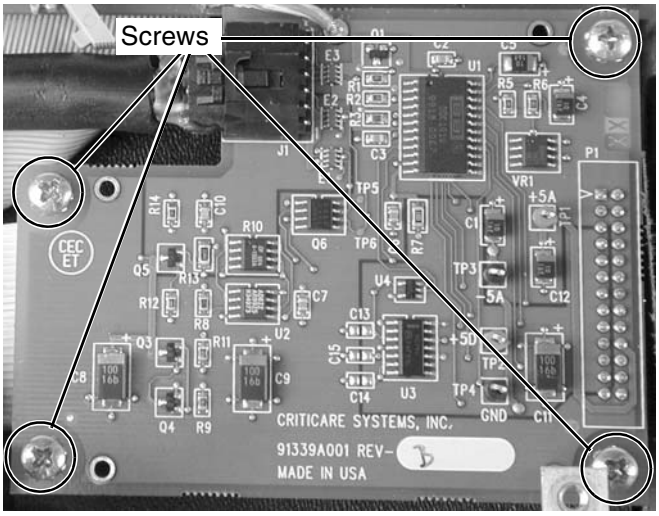


Figure 7-34: Screws Holding the SpO_2 Board

6. Remove the SpO_2 Board.
7. The communication cable to the ECG/Analog Board is attached to the back side of the SpO_2 Board. The ribbon cable with the ferrite case is held on with double sided foam tape. Carefully pull the ferrite casing away from the board.
8. Disconnect the ribbon cable at P1 on the SpO_2 Board.

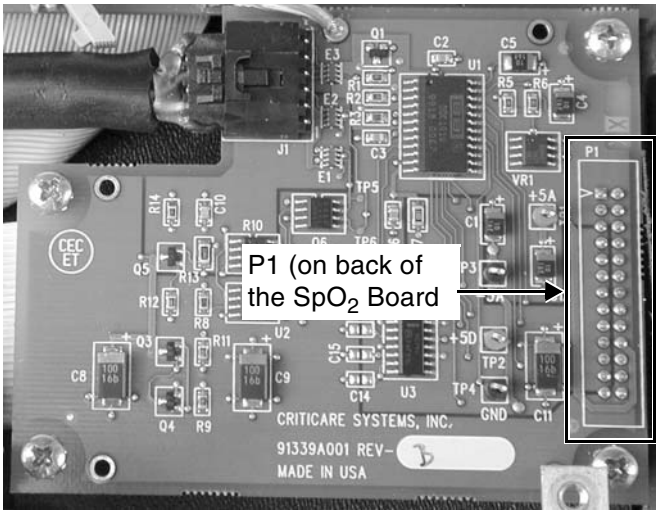


Figure 7-35: P1 on the SpO_2 Board

9. Clean away the old foam tape. Use new foam tape to reattach the ribbon cable assembly.
10. Reverse these steps to place a new SpO_2 Board in the monitor and reassemble the monitor.

Front Chassis Removal

The Main Board is attached to a metal chassis along with the vital signs monitoring modules. You can remove these components as an assembly.

NOTE: Criticare advises that you remove the Main Board prior to removing the Front Chassis. See “Main Board Removal/ Replacement” on page 7-14.

1. Remove the printer from the monitor. See “Printer Removal/ Replacement” on page 7-13.
2. Remove the two Phillips screws hidden beneath the printer module.

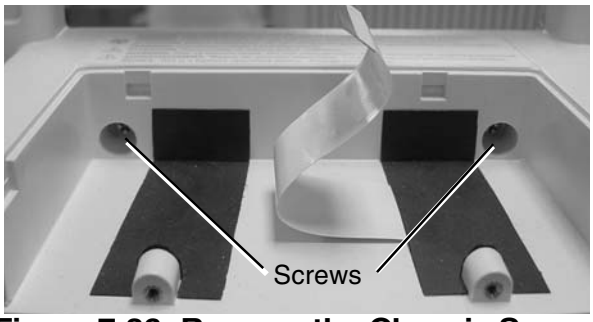


Figure 7-36: Remove the Chassis Screws

3. Remove the two Phillips screws that hold the O_2 sensor door.
4. Remove the exhaust tubing and the CO_2 absorber from the O_2 sensor door. See “Oxygen Sensor Replacement” in Section 5.

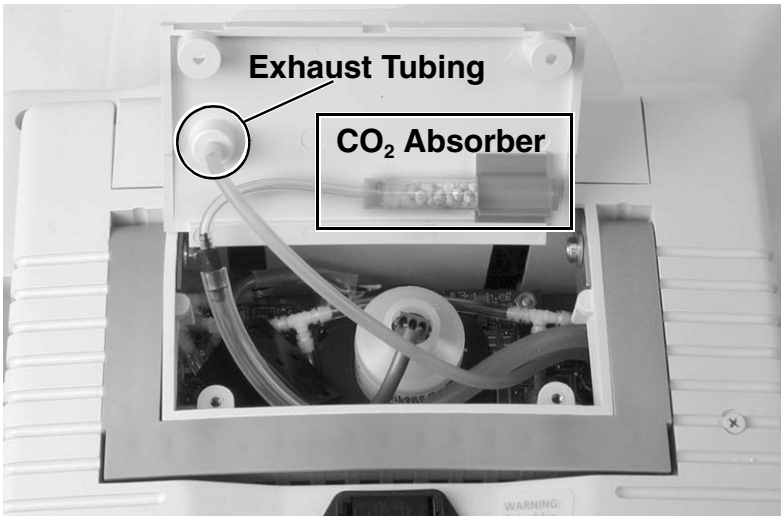


Figure 7-37: Remove the Exhaust Tubing, CO_2 Absorber

5. Turn the monitor over and remove the two bottom screws.

   NOTE: Early model units have front rubber feet. Later production units have a single front foot brace. Both the feet and the brace use the same two screw mounts.

Figure 7-38: Remove the Foot/Foot Brace Screws

6. Gently pull the front chassis from the rear housing. This exposes the gas module assembly if the monitor has the optional CO_2 or CO_2/O_2 modules.

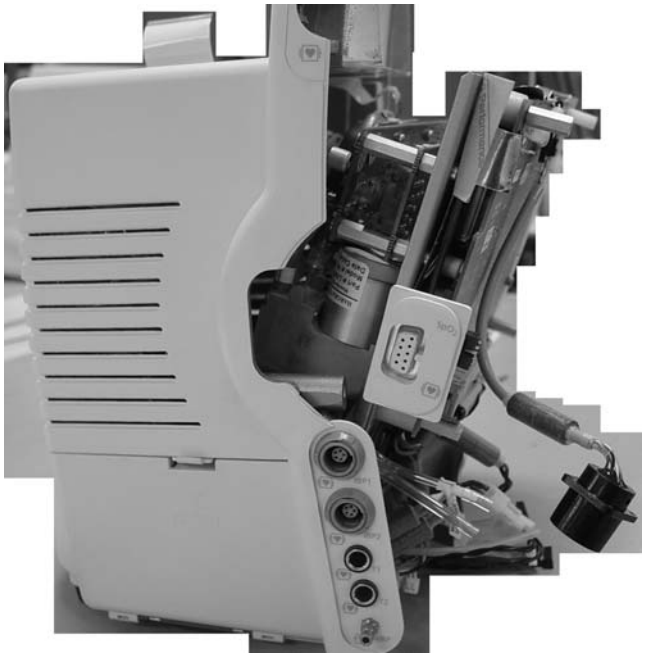


Figure 7-39: Remove the Front Chassis

NOTE: When you reinstall the metal chassis assembly, reconnect all tubes. Do not crush or pinch the tubes when you replace the chassis.

7. To expose the power cables, carefully lay the front chassis assembly flat onto the bench top.

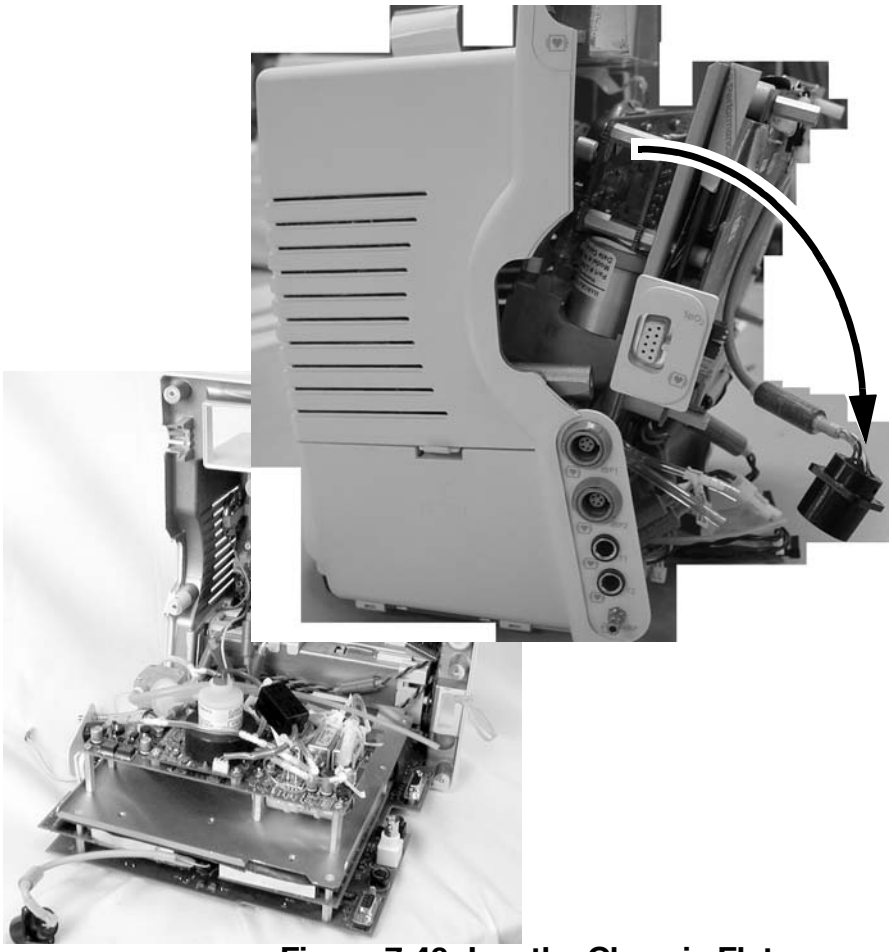


Figure 7-40: Lay the Chassis Flat

ECG/Analog Board Removal/Replacement

The ECG/Analog Board is located behind the Main Board. The SpO_2 Board is located near the lower right corner of the ECG/Analog Board.

1. Detach the communication ribbon cable at P5 of the ECG/Analog Board.
2. There is a hard wire ground between the ECG/Analog Board and the SpO_2 Board. Desolder the ground wire at the ECG/Analog Board.

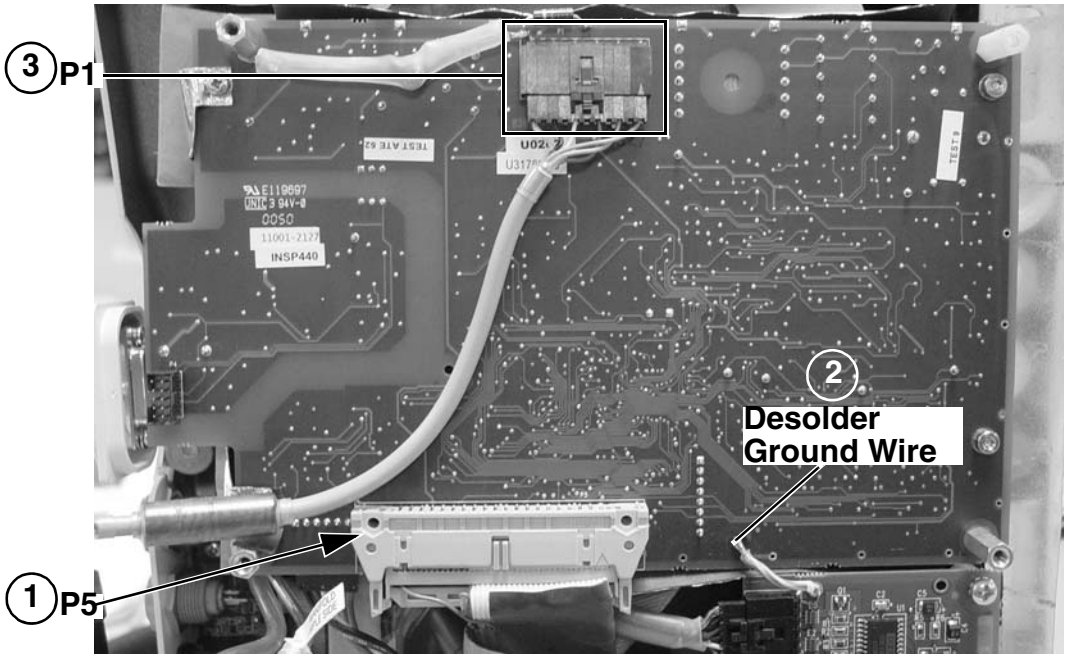


Figure 7-41: ECG/Analog Board

3. Label and disconnect the ECG cable assembly from P1 on the ECG/Analog Board.
4. Remove the four standoffs holding the ECG/Analog Board in place.

   NOTE: The standoff in the upper right corner is plastic and this standoff MUST return to this position in reassembly.

5. Lift the ECG/Analog Board from the chassis.

   NOTE: The upper left corner has a capacitor that must pass through the eye of the standoff.

6. Remove the four screws and washers and remove the shielding from the ECG/Analog Board.
7. Replace the ECG/Analog Board and reassemble in reverse order.

CO_2/O_2 Removal/ Replacement

NOTE: Make sure that when you order a CO_2 Board that the CO_2 Board is factory calibrated.

1. Remove the six Phillips screws from the standoffs.

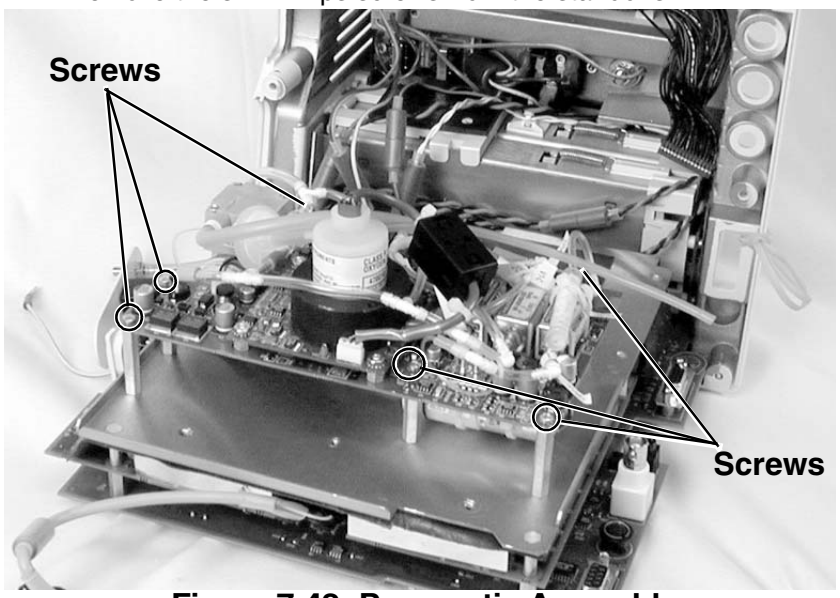


Figure 7-42: Pneumatic Assembly

2. Disconnect the pump wires from J3 on the CO_2 Board.

Figure 7-43: CO_2 Board

3. Disconnect the ribbon cable from J2 on the CO_2 Board.
4. Disconnect the “PUMP IN” tube from the pump.

5. If an O_2 Board with manifold is attached, remove the four nuts that hold the O_2 Board to the CO_2 Board (if necessary). Remove the cable at J1 of the CO_2 Board (if replacing the CO_2 Board) or J2 of the O_2 Board (if replacing the O_2 Board). Remove the O_2 cell.

Figure 7-44: O_2 Board

6. Reassemble either or both boards in reverse order. Replacement of either the O_2 Board or the CO_2 Board requires user calibration for both boards. See **Section 6** for calibration procedures.

NOTE: If you need to replace the IBP Board or the NIBP Pump or Valve, perform these procedures before you reassemble the unit. See “IBP Board Removal/Replacement” on page 7-26 and/or “NIBP Pump/Valve Removal/Replacement” on page 7-27 for instructions.

IBP Board Removal/ Replacement

1. With the CO_2/O_2 removal complete, remove the three standoffs that hold the IBP in place.
2. Label and remove the cables on the IBP Board.

   NOTE: The IBP Board cables are not unique. Label the cables so that you can reconnect them properly.

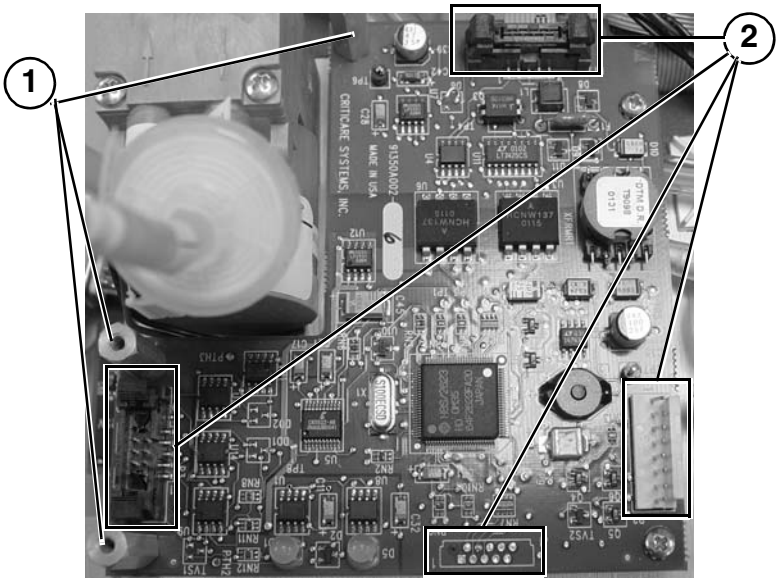


Figure 7-45: IBP Board

3. Remove the two Phillips screws that hold the IBP on the chassis.
4. Replace the IBP Board.
5. Perform an IBP calibration if you replaced the IBP Board.
6. Reassemble in reverse order.

NIBP Pump/Valve Removal/Replacement

1. Follow “CO2/O2 Removal/Replacement” on page 7-24. The NIBP Pump Assembly is located underneath.

   NOTE: If your unit has IBP, you need to remove the IBP Board. See “IBP Board Removal/Replacement” on page 7-26

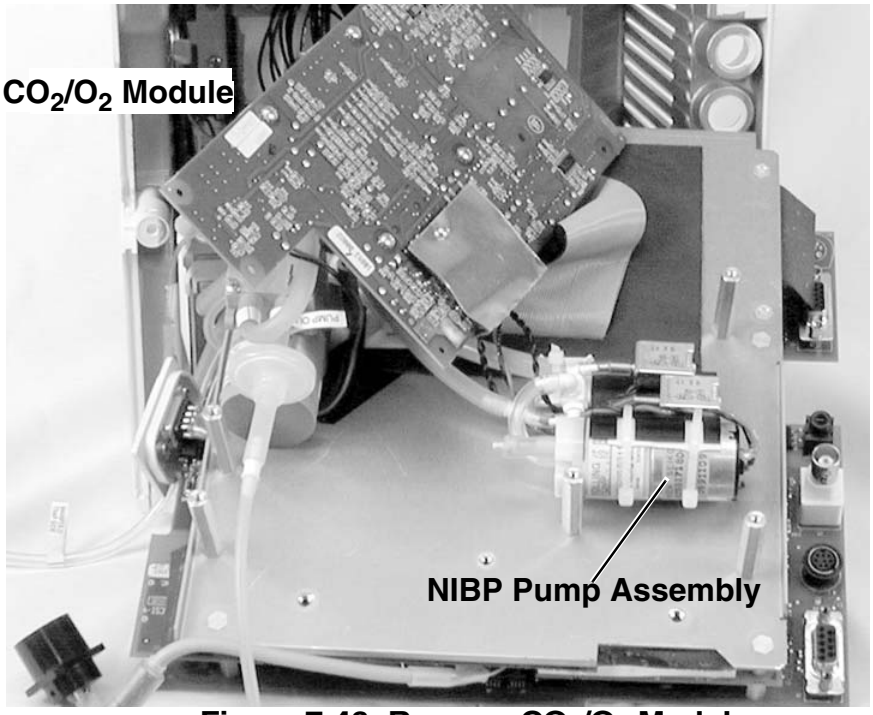


Figure 7-46: Remove CO_2/O_2 Module

2. Remove the pump valve assembly.

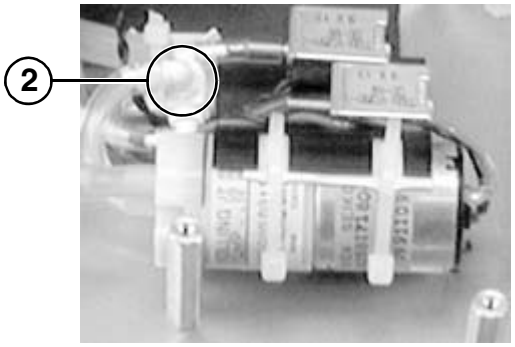


Figure 7-47: NIBP Pump

3. Disconnect the clear tubing from the NIBP connector.

   To remove the entire NIBP assembly, expose the screws holding it to the chassis.

4. Remove the four bushings that are on the chassis.

5. Pull back the insulator from the upper left corner to expose and remove the two Phillips screws.

Figure 7-48: NIBP Assembly Screws

6. Remove the NIBP pump assembly from the chassis.

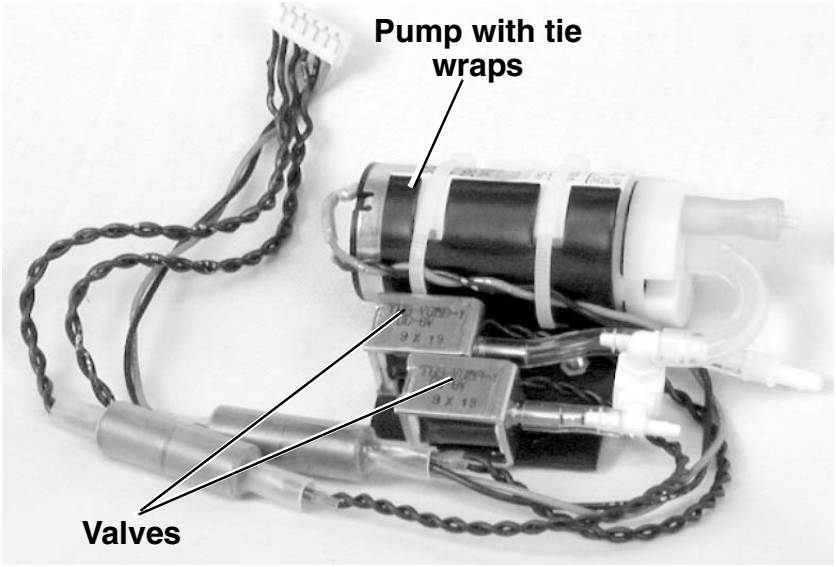


Figure 7-49: NIBP Pump

See “Troubleshooting” in Section 8 for more information about troubleshooting the NIBP assembly.

7. Reassemble with a replacement NIBP pump assembly in reverse order.

Power Module Assembly Removal/Replacement

1. Turn the unit over and remove the six Phillips screws (four small, tan-colored screws and two larger, unpainted screws) from the bottom of the unit.

Figure 7-50: Remove the Bottom Screws

2. Turn the monitor upright and tilt the power supply module out of the rear assembly. You need to carefully lift the power supply assembly from the standoffs by the battery door.

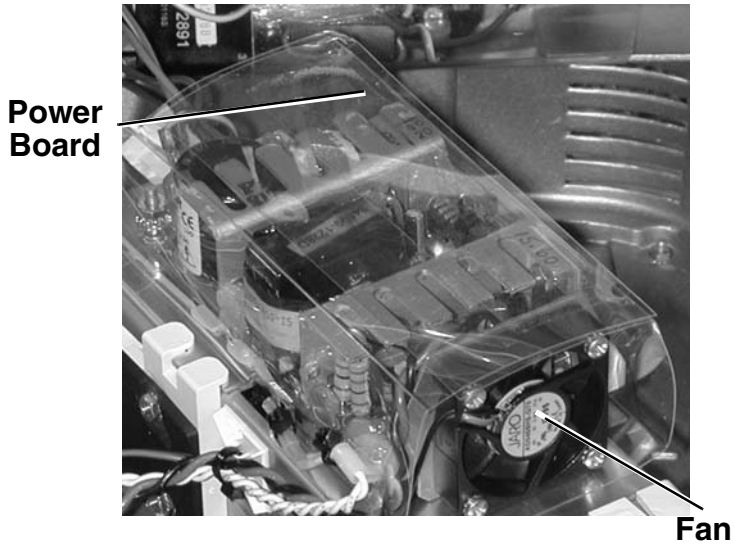


Figure 7-51: Remove the Power Supply Assembly

3. Label and remove the ground cables to the rear assembly. Label and remove the AC power cable at J2 of the Power Supply Board.

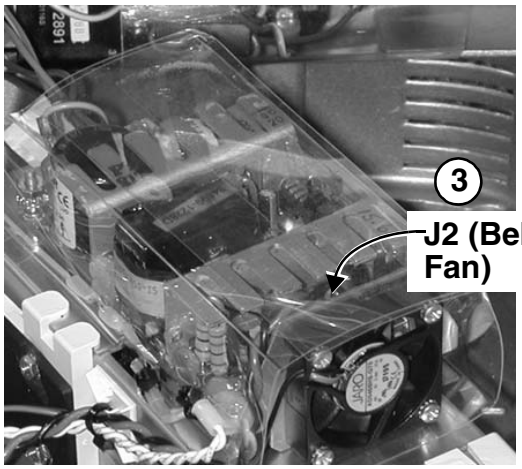


Figure 7-52: Remove the cable from J2

NOTE: For more information about trouble shooting the power supply, refer to “Troubleshooting” in Section 8 in this manual.

4. Replace the power supply assembly.
5. Reassemble the monitor.

Power Supply Board

Do not calibrate or adjust the pot on the Power Supply Board. Low voltage indicates a damage and unsafe power supply. Do not reuse the old insulator when replacing power boards.

Order: 80232C001 Power Supply Board w/coating

New Power Supply Boards are pre-tested and ready for installation. The calibration pot is factory set on new Power Supply Boards.

1. Check the connections to the power module and to the AC Power Entry Assembly (pn 95641A001) for burn marks or discoloration. Replace any assemblies that have been subject to heat damage.
2. Remove the fan from the Power Supply Board.
3. Disconnect the cable from the AC Power Entry Assembly at J1 of the Power Supply Board.
4. Remove the ground connections from the Power Supply Board.
5. Remove the DC power cable (pn 90865A001) at J2 of the Power Supply Board.
6. Remove the clip holding the white thermocouple wire. Be careful not to damage the tip of the wire.
7. Remove the old Power Supply Board. Leave the old protective insulator on the board assembly.

8. Re-assemble the new board onto the power module chassis. The calibration pot is factory set.
9. Re-attach all wires and cables to the Power Supply Board. Reassemble the power module.
10. Replace the board by following all of the steps/sections before this to reassemble the unit.
11. Replacement or repair of the power module requires Hi-Pot and Leakage testing. See “Service Testing and Calibration” in Section 6 for full test procedures.

Reassembling the Monitor

Reassembling the Front Chassis

NOTE: Every step applies for a base unit. All other steps are identified by CO_2, CO_2/O_2, or IBP

Refer to drawing number 92788AXXX in “Drawings and Schematics” in Section 9 of this manual for the following steps.

1. *CO_2, CO_2/O_2*: Mount the CO_2 Pump (Item #1; pn 94253A001) to the Front Chassis (Item #2: pn 42131B001) using two #6 Screws (Item #3; pn 40496B002).

   NOTE: Do not over tighten.

2. *CO_2, CO_2/O_2*: Add Tie Wrap Holder (Item #9; pn 40294B001) to the bottom of the CO2 pump.
3. Mount the NIBP Module assembly (Item #4; pn 94252A001) to the Front Chassis using two #4 Screws (Item #5; pn 40995B005).
4. *CO_2, CO_2/O_2*: Insert the six M/F Standoffs (Item #6; pn 42189C001) into the “PEM” nuts on the Front Chassis.

   CO_2 and IBP: If IBP and CO2 are being built, insert (5) Standoffs (Item 33; pn 42187C001) into the “PEM” nuts on the Front Chassis.

5. Add Insulator Front Chassis (Item #7; pn 83311B001) to the front surface of the Front Chassis.
6. Add Insulator Chassis Back (Item #8; pn 42211B001) to the back surface of the Front Chassis.
7. Place one Tie Wrap Holder (Item #9; pn 40294B001) below the manifold of NIBP. Add a second Tie Wrap Holder approximately 4 inches to the right of the first one, placed on an angle.

   NOTE: For *IBP* units, only the first tie wrap holder is added.

8. Take the Clear Tubing (Item #10; pn 41602B001) and cut to approximately 4 inches long. Slide over the thin piece of tubing coming from the NIBP manifold.
9. Add two Tie Wraps (Item #11; pn 40067B001) to the Tie Wrap Holders on the back surface of the Front Chassis (to retain NIBP Tubing "Conduit").

   NOTE: For *IBP* units, just add the second tie wrap to hold the tubing.

10. Install the IBP board (Item # 35; pn 91350A002) to the top of the standoffs and attach with the two screws (pn 40995B005).

    NOTE: See the assembly print for details on the IBP.

11. *If no CO_2 is present*: Add five screws to mount the IBP to the standoffs.

    If CO_2 is present: Add three standoffs (Item #34; pn 42188B001) to the top of the IBP board and two screws (pn 40995B005) to the IBP board. Add three Standoffs (Item #6; pn 42189C001) to the Front chassis.

    NOTE: See the assembly print for exact locations of these parts.

12. *IBP*: Attach the two Cables 2MM IDC strips (Item #36; pn 83352B001) to the IBP board.

13. *CO_2, CO_2/O_2*: Install the O_2 Module (Item #13; pn 91354A001) onto the CO_2 Module (Item #26; pn 91355A001). Insert the O_2 Module into the CO_2 Board and secure the module with four #4 Hex Nuts (Item #14; pn 40284B001).

Refer to drawing number 91765A001 (O_2), 91766A001 (CO_2), or 91767A001 (CO_2/O_2) or 91354A001 (O_2) and 91355A001 (CO_2) in **Section 9** of this manual for the following step.

14. *CO_2/O_2*: Add CO_2/O_2 Pneumatics (pn 95632A001) to the bench assembly according to the assembly print (91767A001).

    CO_2: Add CO_2 Pneumatics (pn 95632A002) to the bench assembly according to the assembly print (91355A001).

Refer to drawing number 92788AXXX in “Drawings and Schematics” in Section 9 of this manual for the following steps.

15. *CO_2, CO_2/O_2*: Mount the CO_2 (Item #29; pn 91766A001) or CO_2/O_2 Assembly (Item #29; pn 91767A001) to the Front Chassis using six #4 Screws (Item #5; pn 40995B005). Finish by installing the CO_2 exhaust tubing assembly to the output of the pump.

16. *CO_2, CO_2/O_2*: Plug the CO_2 Pump Assembly (Item #1) into the J3 connector on the CO_2 board. Remove the black covers from the Pump.

17. *CO_2, CO_2/O_2*: Insert the CO_2 to the Main Cable (Item #15; pn 87225B001) into the header of the CO_2 Board.

18. Flip the Front Chassis over and slide the Cable Support (Item #24; pn 42212B002) over the four standoffs on the Front Chassis.

19. *CO_2, CO_2/O_2*: Flip the front chassis back over and fold the CO_2 cable to the left, fold the cable at the point where the cable lines up with the Cable support. Fold the creases so they are flat. Insert the cable through that opening. The cable should now be in the front of the chassis.
20. Attach a Tie Wrap Holder (Item #9; pn 40294B001) to the Front Chassis on the right and left-hand side of opening. These are across from each other. Insert a tie wrap (Item #31; pn 40067B002) from the right hand side, leaving the head on the right hand side. This should pass through both tie wrap holders.
21. Install the four plastic Standoffs (Item #16; pn 40909B001) onto the front surface of Front Chassis. (These parts support the SpO_2 Board.)
22. Lay shielding (Item #30; pn 42228B002) down with the "V shape" cut to your left. Obtain the SpO_2-to-Analog Cable (Item #17; pn 90866A001) and place it on top of the shielding with the connectors up.
23. Place the cable along the line that runs horizontally (V-shape). Place the bare wire into the middle of the shield. Fold one side of the shielding on top of the bare wire. Pull the other half and fold it on top of that. Bend the cable and shield to form an "L"-shape.

    NOTE: Keep the connector flush with the edge of the shielding.
24. Install the Ferrite Package (Item #18; pn 82515B001) onto the SpO_2-to-Analog cable. Place a piece of Foam Tape (Item #19; pn 41955B001) to the back of the Ferrite and adhere this to the back surface of the SpO_2 Board.
25. Plug the SpO_2-to-Analog Cable (Item #17; pn 90866A001) into the SpO_2 Board (Item #28; pn 91339A001).
26. *CO_2, CO_2/O_2*: Attach the tubing from V2-C (center valve) to the input port on the CO_2 Pump (Item #1, see arrows on Pump body).
27. *CO_2, CO_2/O_2*: Attach the CO_2 Exhaust Tubing Assembly (pn 95633A001) to the output port on the CO_2 Pump.
28. Mount the SpO_2 Module (Item #28; pn 91339A001) to the Front Chassis Assembly with the four #6 Screws (Item #3; pn 40496B002) onto the plastic Standoffs (Item 16).
29. Plug the SpO_2-to-DB9 Cable with the Plastic Insert (Item #20; pn 95624A001) into J1 of the SpO_2 Board. Route the cable between the mounting standoffs for the Analog Board.
30. Cut four 1" x 1" Double Sided Tape (Item #37; pn 40683B001) and place them onto the Insulating Bushings (pn 42230B002).

31. Install the Insulating Bushings (Item #31; pn 42230B002) over the four stand-offs that mount the Analog Board.
32. Add 1 inch of Shrink Tubing (Item #32; pn 40041B009) to the mounting flanges of the Front Chassis per the assembly drawing.
33. Add a Tie wrap (Item #11; pn 40067B001) through the tie wrap holder on the bottom of the pump and secure the pneumatics for the manifold intake.

Final Assembly Rebuild

Refer to drawing number 93951AXXX in "Drawings and Schematics" in Section 9 of this manual for the following steps.

1. Attach the power supply ground cable from the multi-ground cable (pn 90883A001) to the stud on the power module (Item #7; pn 95612A001) using a keps nut (Item #26; pn 40284B002).
2. Attach the ground power supply cable from multi-ground cable to the quick disconnect on the power module circuit board. (pn 80232C001).
3. Attach wire harness from Isolation PCB to the input of power supply.
4. Attach shielding with the last strip of tape. All three cables should be routed around the shielding.
5. Install the Power Module Assembly (Item # 7; pn 95612A001) into the rear housing (Item 1; pn 93258A001) over the battery door hinge.
6. Insert the four painted screws (pn 42065B004) into the bottom of the rear chassis assembly (pn 93258A001) to secure the power supply module.
7. Before you tighten all the screws on the side by the battery door, close battery door and then tighten the screws. This allows the battery door to function properly.
8. Route the white thermister, black/red fan, blood pressure, GND cable, and speaker cables through the opening in the front chassis.

   NOTE: Pull all ferrites to the ends of the cables and through the opening of the window.
9. Position the Front chassis (Item #5; pn 92788AXXX) into the rear housing.
10. Route the printer cable above the front chassis.
11. Route the tubing from the CO_2 bench to the left side. Also route the Battery cable, NIBP hose, GND wire, NIBP, and NIBP transducer hose through the left side of the chassis.

    NOTE: All ferrites are to be as close to the connectors as possible.

12. Route the AC cable through the top half of the window of the front chassis. This cable does not have to be secured down with the others.
13. Place the front chassis into the rear housing and secure with two screws (Item #35; pn 40876B001) through the back of the top of the chassis.
14. Place Front Support (Item #21; pn 42225B001) onto bottom of chassis, insert two screws (Item #36; pn 40873B004) into holes and attach to chassis. Attach a Clip (Item #22; pn 42227B001) to bottom of Front Support.
15. Be sure that the SpO_2 cable assembly fits into slot on side of rear housing and attach it to the SpO_2 board.
16. Attach the front chassis ground wire from multiple ground cable to the stud located on the bottom surface of the front chassis using one nut (Item #25; pn 40284B001).
17. Slide all ferrites up to the point at which the tie wraps (pn 40067B001) are your center point—three ferrites on the backside and two on the front side, but only in the space provided between the tie wrap holders.

    NOTE: Make sure all ferrites do not fall behind the front chassis assembly.
18. Add a last tie wrap to other the tie wrap. Pull the tie wraps tightly and secure all ferrites in place.
19. Verify that the RTV is placed on the ECG/Analog Board at T2 @ Solder Lugs to Ferrite Case.
20. Attach the shielding (pn 41875B004) to the ECG/Analog Board (pn 91342A002) by placing the four screws (pn 40995B005) through four washers (pn 40086B001). Attach insulator (pn 83358B001) to the top of the shielding near the opening at T2.
21. Plug the ECG cable assembly (pn 90871A002) into the ECG/Analog Board P1 and route the ferrite into the handle.
22. Insert the ECG/Analog Board with shielding (Item #10; pn 91353A002 or 91353A001) onto the standoffs on the front chassis.
23. Tighten the board down with the two standoffs (Item #38; pn 42175B001), one to the bottom right and the other to the bottom left. Tighten the standoffs down firmly. Add a plastic standoff (Item #46; pn 40909B002) to the top right hand corner.
24. Add the last standoff to the upper left by placing it through the ring of the cap assembly on the ECG/Analog Board.
25. Solder the SpO_2 GND cable from the SpO_2 Board to the ECG/Analog Board.

26. *If the assembly is a Temp/NIBP Assembly*: Place the assembly in its slot on the left. Attach the NIBP tubing to the quick connect fitting. There should be a ground cable left over.

    If the unit contains an IBP Board: Mount the IBP connector panel using two screws (pn 40995B001) and attach them to the rear housing.

    If the unit is 2-Temp only: Mount the board onto the standoff(s) that are provided and secure with two screws (Item #28; pn 40995B001).

27. There should be a ground cable left over. Attach the GND cable from the multiground to the NIBP fitting (pn 42014B001) and secure it with the nut (pn 40284B005). Verify that the tubing from the NIBP runs along the Front chassis on the left side clearing all the ferrites under the transducer tubing.

28. Connect the SpO_2 cable from P1 of the SpO_2 Board to P5 of the ECG/Analog Board.

    NOTE: If the unit has CO_2, then keep the CO_2 cable behind and to the left of the SpO_2 cable at this point.

29. Wrap the CO_2 cable over the SpO_2 cable and fold the cable so that the head of the connector faces you. Attach a tie wrap (40067B003) to the whole cable covering the both cables and pull tight. Keep the head of the tie wrap near to the right side (near the SpO_2 board) and tucking it in under the board.

30. Attach the other end of the printer cable to the printer assembly (Item #18; pn 95604A001).

    NOTE: This can be only used if a A001 or A011 is present. If you use Main Board (-A002) or better, use printer assembly Item #18; pn 95604A002.

31. Use the two screws (Item #29; pn 40995B006) to secure the printer assembly to the rear housing.

32. *If the unit is a non-printer*, place two screws (Item #29; pn 40995B006) through the cover printer opening (pn 45114B001).

33. Turn the unit back around with the circuit boards facing you.

34. Verify that all the ferrites are between the window of the chassis.

35. Make sure all pneumatics are left hanging out. There should be only two tubes on monitors without CO_2; on monitors with CO2 there should be 4 tubes.

36. Place the Main Board down with J11 (BNC) upwards and to the right. Most of the connectors face upward. Connect the following to the Main Board:
    a. Connect the speaker cable to J20.
    b. Connect the fan cable to J19.
    c. Connect the thermister cable to J18.
    d. Connect the CO_2 cable to J16 (If monitor has CO_2.
    e. Connect the NIBP cable to P2.
    f. Connect the IBP cable from the P1 connector by the fuse on the IBP Board to J14. Connect the other IBP cable from the P2 connector on the IBP Board to the Connector Board.
    g. Connect the Power Supply cable to PS2.

       NOTE: Do not route this cable through the window.

    h. Connect the Battery cable to PS1
    i. Connect the blue tygon tubing to the pressure transducer at SENS1.

       NOTE: Make sure that when you place the Main Board into the unit that this tubing is clear from being kinked. Route the tubing above the battery cables.
37. Secure the Main Board to the chassis with the five screws (Item #33; pn 40496B001).

    NOTE: Make sure the connector for ECG is secure. The left side-middle is not installed until later.
38. Attach the same screw through the Cap assembly on the Main Board (pn 95653A001). This is found on the right hand side of the board.
39. Position the front housing assembly (Item #3; pn 92759AXXX) in front of the rear housing and connect the ground wire to the Main Board mounting point.
40. Insert the last screw (Item #33; pn 40496B001) through the ground wire lug from the front housing and secure it to the middle left hand side of the Main Board.

    NOTE: Make sure the lug faces outward.
41. Attach the quick connect tab from PS1 to the female tab of the display.
42. *If the unit has a printer*, plug the printer cable into the Main Board at J1.

43. Attach the encoder cable to J8. Make sure that the cable is folded flat back over the connector and not pinched in between the enclosures.
44. Attach the membrane switch to J7. Make sure that the lock is seated all the way down.

    NOTE: The dark blue side faces to the right.
45. Connect the display cable to the Main Board at J3.
46. Connect the inverter cable to the Main Board at J4.
47. *CO_2/O_2*: Connect the manifold trap side to the water check (outside fitting).
48. *CO_2/O_2*: Connect the manifold sample side to the water check (inside fitting).
49. Verify that the ECG cable is inserted into the groove provided at the top of the case with the connector key facing up.
50. Secure the front and rear housings together with eight screws. Seven (Item #47; pn 40496B006) are placed: three in the handle, two in middle and two in the bottom outside. One (Item #33; pn 40496B001) at the bottom center.
51. *CO_2/O_2*: Attach the exhaust tubing from the CO_2 bench to the O_2 sensor door (pn 42132B001).
52. *CO_2/O_2*: Attach the CO_2 absorber to the cord clip (PN: 42227B001) on the O_2 sensor door.
53. Attach the door with two screws (Item #29; pn 40995B006).
54. Insert a battery (Item #40; pn 83278B001) into the unit.
55. Add the Hypertronics connector (Item #52; pn 83375B001) to the back of the 8100.
56. Make sure the label is still attached to the bottom of the unit. The label should contain the Cat number for the first line, the serial number for the second line, and the drawing number for the unit. It should look like this:

    81XYYYZAABCD (B=E FOR ENGLISH)

    XXX-XXXXXX

    93951AXXX
57. Insert screws (Item #60; pn 40873B001) into the bottom of the unit. These are used for mounting the roll stand.

Assembly Tests

Front Chassis Check Off Sheet

	INITIALS
1. Mount the CO_2 Pump	_____
2. Add the tie wrap holder under the pump	_____
3. Mount the NIBP Module Assembly.	_____
4. Insert the Standoffs for the CO_2 Module	_____
5. Insert the Standoffs for the IBP Module	_____
6. Add the insulator to the Front Chassis	_____
7. Add the insulator to the back of the Front Chassis	_____
8. Add two tie wrap holders	_____
9. Add the NIBP tubing conduit	_____
10. Add tie wraps to hold the tubing	_____
11. Install the IBP board with screws	_____
12. Add additional screws if CO_2 is not present	_____
13. Add standoffs to the top of the IBP board	_____
14. Attach the IBP cables to the board	_____
15. Install the O_2 Module	_____
16. Add pneumatics for $CO_2/0_2$	_____
17. Add pneumatics for CO_2	_____
18. Install bench with screws	_____
19. Plug CO_2 Pump into J3 on CO_2 Board	_____
20. Plug Main/CO_2 Cable into CO_2 Board	_____
21. Add cable support	_____
22. Fold CO_2 cable and pull it through front of chassis	_____
23. Add tie wraps and holders	_____
24. Insert plastic standoffs	_____
25. Lie cable down with shielding underneath	_____
26. Wrap cable in shielding	_____
27. Install ferrite with tape	_____
28. Plug the SpO_2 to Analog cable into SpO_2 board	_____
29. Attach tubing from valve 2 to pump in	_____
30. Attach exhaust tubing to pump out	_____
31. Attach four screws to hold SpO_2 board down	_____
32. Insert SpO_2 cable into J1	_____
33. Add double-sided tape to bushings	_____
34. Install Insulator Bushings	_____
35. Add shrink tubing to mounting flanges of Front Chassis	_____
36. Add tie wrap to hold pneumatics for manifold intake	_____

Final Assembly Check Off

	INITIALS
37. Verify that the ground cableis attached with the nut to the power module.	_____
38. Verify that the quick connect is connected to power module	_____
39. Verify that wire harness is attached to the input of the power supply	_____
40. Attach shielding with tape	_____
41. Install power module assembly	_____
42. Install four screws to hold Power Supply Assembly in place	_____
43. Verify that battery door has been adjusted	_____
44. Verify cables are routed properly and pulled through window	_____
45. Position Front Chassis into rear housing	_____
46. Route printer cable above front chassis	_____
47. Verify CO_2 tubing is routed to the left side	_____
48. Verify Battery cable, GND, and NIBP hoses are routed to left side of chassis	_____
49. Verify that AC cable is routed through the top of the chassis	_____
50. Place Front chassis into rear and secure with top screws	_____
51. Connect front support with screws into chassis	_____
52. Insert SpO_2 cable into SpO_2 board	_____
53. Attach ground wire to front chassis	_____
54. Slide up all ferrites, so that they lie under the tie wrap	_____
55. Secure all ferrites under tie wrap and pull tight	_____
56. Verify that RTV is applied to T2 @ solder lugs	_____
57. Verify shielding is attached (91342A001) only	_____
58. Verify bare wire is attach from TP1 to shield (91342A001) only	_____
59. Attach ECG cable to J1 of the Analog board (91342A001) only	_____
60. Assemble Shielding to ECG board using screws and washers (91342A002)	_____
61. Plug ECG cable (90871A002) into analog board	_____
62. Install ECG board with standoffs	_____
63. Verify 2 standoffs and 1 plastic standoff	_____
64. Add last standoff through Cap assembly	_____
65. Solder ground from SpO_2 board to Analog board	_____
66. If TEMP/NIBP place it on the left	_____
67. Install the correct connector assembly	_____
68. Mount the plate and the connector board and attach cable to ECG Bd.	_____
69. Mount The IBP connector assembly to the rear housing	_____
70. Mount board for 2-temp units	_____
71. Connect GND cable to NIBP fitting and nut	_____
72. Connect interface cable from the SpO_2 to the Analog board	_____
73. Attach Tie wrap to CO_2 cable	_____
74. Attach the printer cable to printer assembly (95604A001) only	_____
75. Attach the printer cable to Printer assembly (95604A002) only	_____
76. Secure printer assembly with two screws	_____

Final Assembly Check Off (Con't)

	INITIALS
77.If unit is non-printer attach non-printer door	_____
78.Turn unit around	_____
79.Verify that all the ferrite are between the window of the chassis	_____
80.If CO_2 is applicable, make sure both tubing's are to the left	_____
81.Place Main board face down with J11 facing upwards	_____
a. Verify that the speaker is attached @J20	_____
b. Verify that the fan cable is attached @J19	_____
c. Verify that the thermister is attached @J18	_____
d. Verify that the CO_2 cable is attached @J16	_____
e. Verify that the NIBP cable is attached @P2	_____
f. Connect IBP to J14	_____
g. Connect IBP to connector board	_____
h. Verify that the AC cable is attached @PS2	_____
i. Verify that the Battery cable is attached @ PS1	_____
j. Verify that the blue tygon is attached to pressure xdr.	_____
82.Secure main board with six screws	_____
83.Attach one screw through Cap assembly	_____
84.Connect GND wire from front housing to main board	_____
85.Install last screw to hold gnd wire lug	_____
86.Attach female tab to male tab on display	_____
87.Plug printer cable into J1	_____
88.Attach encoder to J8	_____
89.Attach membrane switch to J7	_____
90.Connect display cable to J2 if it is a Passive	_____
91.Connect display cable to J3 if it is a Active	_____
92.Connect inverter cable to J4	_____
93.Connect trap side to manifold	_____
94.Connect manifold side to manifold	_____
95.Insert ECG cable into rear housing	_____
96.Secure front housing to back housing with 8 screws	_____
97.Connect exhaust tubing to O_2 door fitting.	_____
98.Attach CO_2 absorber to cord clip on door	_____
99.Attach the door with 2 screws	_____
100.Insert battery into battery compartment	_____
101.Add connector to back of housing	_____
102.Add serial label to bottom of the unit	_____
103.Add screws to bottom of unit	_____

Assembly Electronic Test

	Pass	Fail
Plug an AC cord into the unit.		
The green AC light should be on.	_____	_____
Hit the Power key.		
The display should show CSI with current revision of software.	_____	_____
Check for proper operation of pump by hitting the "NIBP" key.		
To insure the membrane buttons are operable, hit the following keys in sequence and listen for the beep:		
FREEZE	_____	_____
NIBP CYCLE/STAT	_____	_____
NIBP	_____	_____
PRINT	_____	_____
SILENCE	_____	_____
DEFAULT	_____	_____
TREND	_____	_____
STANDBY	_____	_____
Rotate the Encoder knob and verify the cursor moves.	_____	_____
Press the encoder and verify a menu is selected.	_____	_____
Press the encoder again to exit.	_____	_____

Section 8 — Troubleshooting

This section lists the possible causes of monitor problems. Use this table and the schematics in “Drawings and Schematics” in Section 9 to identify and locate components that malfunction.

Symptom	Problem	Solution
Unit won’t power up (On/Off LED is dark)	• Battery is discharged	Connect AC power cord
	• AC power cord is not securely connected to monitor	Connect AC power cord to monitor
	• AC outlet off or unpowered	Connect power cord to a live outlet
	• Fuses are blown (Located above AC connection	Replace AC fuses (pn 80131B002)
	• Main Board is disconnected	Reconnect DC power cable at PS2 on Main Board
	• Bad membrane	Replace the keypad membrane
	• Main Board fuse blown	Replace F3 on Main Board
	• Battery fuses are blown	Replace F1 and F2 on Main Board
Cannot activate hardkey function or turn on monitor with AC power (On/Off LED is green)	• Membrane panel is disconnected or loose	Reconnect ribbon cable to J7 on Main Board
	• Keypad membrane is bad	Replace keypad membrane panel
Display is blank or not readable	• Video screen cables to Main Board are disconnected or loose	Reconnect data and inverter cables to connectors on Main Board (J2, J3, J4, and/or J5)
	• Inverter not plugged in	Make sure all Inverter connections are secure.
	• Bad inverter	Replace the inverter
NIBP air leak	• Defective cuff	Replace Cuff
	• Defective hose	Replace Hose
	• Pneumatic tube leaks	Re-seat tube or replace pneumatics.
	• Defective valve	Contact CSI Service Department.
NIBP not functioning	• Pump disconnected	Reconnect pump to P2 on Main Board
	• Pump motor failure	Contact CSI Service Dept.
	• Main Board pump driver bad	Contact CSI Service Dept.
	• NIBP calibration error	Contact CSI Service Dept.
SpO_2 not functioning	• SpO_2 Board disconnected	Reconnect to P5 on ECG/Analog Board and check the connection at P1 on SpO_2 Board
	• ECG S1 switch set wrong	Adjust switches to correct module (1-4 OFF for DOX SpO_2)
	• Software problem	Contact CSI Service Dept.

Symptom	Problem	Solution
ECG noise or intermittent function	• Poor electrode placement • Bad/wrong ECG Cable • Line Frequency/Filter wrong • ECG connection worn • Cable to ECG/Analog Board bad	Reposition/replace electrodes Replace ECG cable Check ECG settings Replace ECG port Replace cable assembly at P1 on ECG/Analog Board
SpO_2 is “noisy”	• Sensor may be bad. • Receptacle may be damaged. • The connection between Main Board J12 and ECG/ Analog Board P4 is loose or disconnected. • Main Board or ECG/Analog Board may be bad.	Replace the sensor. Replace receptacle. Reseat the connection. Replace Board(s)
Trap error or CO_2 mal-function	• Trap is plugged or leaks • Tubes to the trap manifold are loose or pinched • Bad valve or pump • O_2 Cell is loose	Replace trap Check manifold connections Contact CSI Service Dept. Tighten O_2 Cell
O_2 not responding (CO_2 functioning ok)	• O_2 Cell depleted • Cable not connected	Replace O_2 Cell Attach the cable to top of O_2 Cell
No sound from speaker	• Volume turned down • Main Board connection is disconnected or loose • Speaker wire broken at speaker terminals	Set volume higher in Configuration window. Reconnect J20 on Main Board Check speaker wires for breaks or bad crimp pins
Speaker scratchy or unclear	• Metal debris on speaker • Bad speaker	Remove debris from speaker drum Replace speaker
COM 1 serial interface doesn’t work	• Set to internal printer • Incorrect or bad cable • Setting mismatch • Connector is bad	Reset monitor to external printer Replace with correct serial cable Reset baud rate and other settings Replace the Main Board
No ECG trace displays	• ECG Cable may be bad. • The connection between Main Board J12 and ECG/ Analog Board P4 is loose or disconnected. • Main Board or ECG/Analog Board may be bad.	Replace with known good cable. Reseat the connection. Replace Board(s)

Troubleshooting and Repair

Before attempting to repair a damaged monitor the technician must fully understand the functions of the monitor. The service technician should have read and understood all the previous sections of this manual.

You must fully repair, calibrate, and test all damaged monitors before you use them on patients. The monitor must meet the original operating specifications before you use it on a patient.

Always follow ESD precautions when performing any of the procedures discussed in this section.

ComfortCuff NIBP Module

The NIBP module consists of a pneumatic pump assembly (pn 95576A003) and control circuitry located on the Main Board (pn 91340A003).

The pneumatics assembly is mounted on the back side of the metal chassis plate. A large diameter tube (pn 41602B001) connects to the Quick-Connect hardware fixture. A small diameter tube connects to the transducer on the Main Board. The transducer port faces out the back side of the Main Board through a hole.

The remaining pneumatics links connect the two control valves (pn 95596A002), the pump (pn 94252A001), and the check valve (pn 41579B003). As the tubing ages it may lose its seal. Old tubing can be re-seated or replaced as necessary.

When any major pneumatic component such as a pump or valve is replaced, the NIBP module must be re-calibrated as in “NIBP Calibration” on page 6-5 of this manual. The manufacturer recommends that the monitor be returned to a CSI authorized service facility if pump replacement is required.

The transducer SENS1 and the zero point calibration pot R92 are not field serviceable components. Improper replacement can result in permanent damage to the Main Board.

ECG/Impedance Respiration Module

The ECG module is located on the ECG/Analog Board assembly (pn 91353A002) that is attached to the metal chassis behind the main board.

The ECG/Analog Board fits directly on to the Main Board through a socketed 10-pin connection on the left side of the board assembly. There is also a shielded cable assembly that extends from the top of the board to the external ECG port. Check each of these connection points if the monitor fails to produce an accurate ECG waveform.

The ECG/Analog Board has a foil shield to reduce noise from other portions of the monitor. Noise can be introduced by worn cable assemblies and degraded power supplies. Test the analog ECG waveform signal and the input power where they enter the ECG/ Analog Board for interference noise.

There is a replacable 2-amp fuse (pn 80004B003) at location F1 on the ECG/Analog Board. The fuse provides protection in the power circuit leading from the P4 connection to the Main Board. Surface mount components on the ECG/Analog Board are not recommended for field repair and replacement.

You can replace the ECG/Analog Board assembly as a serviceable component. Replacement ECG/Analog Board assemblies, (pn 91353A002) are pre-tested, software loaded, and calibrated. The monitor requires complete safety testing after reassembly.

NOTE: Always check line frequency, filter settings and the ECG lead cables as part of any ECG trouble shooting. Always use the recommended simulators for performance testing.

Board Settings and Module Software

There are three pots under the shielding at locations R112, R110, and R108. They are the baseline adjustments for ECG I, EGG II, and ECG V respectively. These are factory set; you should not adjust them. Set the S1 switches (off) in the open position to allow communication with the DOX module. See “ECG Verification” on page 5-21.

The ECG/Analog Board contains its own on-board software that is factory loaded. The program is stored in non-volatile memory on the ECG/Analog Board. Repair or improper handling of the ECG/Analog Board can corrupt this software.

Respiration

The respiration circuit is located on the ECG/Analog Board. There is no separate calibration or testing for the impedance respiration. See procedure 91342T002 for more information.

Temperature

The temperature module is located on the ECG/Analog Board. There are no on-board settings or service calibrations. The temperature module is auto-calibrating upon start-up.

DOX SpO_2 Module

The DOX SpO_2 module consists of a separate board that is attached near the bottom edge of the ECG/Analog Board. There is a communication connection for a ribbon cable (pn 90866A001) at the bottom edge of the ECG/Analog Board. The ribbon cable extends to the SpO_2 Board. There is also a short ground cable to the ECG/Analog Board (90866A001) that also contains a shield (pn 90866A001).

The plethysmograph input signal enters the SpO_2 Board through a shielded cable that runs between the boards and metal chassis to the opposite side of the monitor.

The DOX SpO_2 module is composed of digital components that are not effected by noise. There is also no signal degradation or loss of calibration due to analog components. Interference or noisy signal can be due to a worn cable assembly or DB-9 connector. Replace the connector and cable assembly if necessary.

Always check the sensor when intermittent problems are reported. Stretched or otherwise damaged sensor cables must be replaced.

NOTE: The line frequency setting of the monitor must be set correctly for optimal SpO_2 monitoring.

CO_2 Module

The CO_2 Module Assembly (pn 91355A001) is not a field-repairable component. The CO_2 module and board require factory calibration tables that can be corrupted by improper servicing. The equipment and procedures for complete servicing are beyond the scope of this manual.

A limited number of procedures are approved for field service. Follow the disassembly procedures as described in “Disassembly” in Section 7 of this manual. After you reassemble and calibrate the monitor you must perform safety testing as described in “Service Testing and Calibration” in Section 6.

Replacement of any of the following CO_2 components must be followed by a gas field calibration as described in “Gas Calibration” on page 6-8 of this manual.

CO_2 Absorber

You may replace the CO_2 absorber (pn 40570B003) without affecting the factory settings of the module. If the CO_2 absorber is degraded, the monitor may not calibrate properly.

The CO_2 absorber is a 2 inch long cylinder located along the left edge of the CO_2 Board or mounted on the rear access panel. Remove and replace the CO_2 absorber cylinder as necessary. One end of the absorber must be open as a sampling port during calibration.

A field calibration of the gas module must be performed to ensure that the module was reassembled correctly.

CO_2 Pneumatics

Obviously damaged, leaking or degraded tubing can be replaced without affecting the factory settings of the CO_2 module. See drawing 95628A001 in "Drawings and Schematics" in Section 9 of this manual for details on the pneumatics assembly.

- For monitors with CO_2 and O_2 use Tubing Set (pn 95632A001).
- For monitors without O_2 use Tubing Set (pn 95632A002).

CO_2 Pump Replacement

You can replace failed or intermittent pump assemblies (pn 94253A001). See drawing 92788A011 in "Drawings and Schematics" in Section 9.

CO_2 Module Replacement

The CO_2 Module Assembly (CO_2 only: pn 91766A001; CO_2 with O_2: pn 91767A001) is available as a total replacement. Replacement assemblies are pre-tested as a finished assembly module.

Before you replace the CO_2 module confirm that the problem is not due to a bad absorber, poor cable connections, leaky pneumatics or a failed pump assembly. The new CO_2 module must be field calibrated with the pump assembly that is installed with it.

You can recover the O_2 module (pn 91354A001) from the old CO_2 module. Recalibrate the O_2 module after performing any service on the CO_2 module.

Main Board

The Main Board (pn 91340A003) contains the primary processors, storage memory, NIBP circuitry, communication interfaces, audio driver, vital signs module connections, power regulation, battery charge circuits, and video generation and keypad inputs (User I/O).

The main ground cable (pn 95637A001) and the display ground cable (pn 95642A001) are part of the Main Board assembly.

The Main Board has an adjustable pot R29 that you set during NIBP calibration. There are two CPUs on the Main Board that you must program from a CSI Service Download Station. The programmable settings remain in non-volatile memory. Repair or improper handling of the Main Board can corrupt this software. See procedure 91340T003 for more information.

There are two replacable 3-amp fuses (pn 82004B001) for the battery input at PS1. There is one replaceable fuse (pn 82004B001) for the power supply module at PS2 (F4 protects the supply output).

If you replace the Main Board you are required to cal-check the NIBP module. NIBP pneumatics assemblies and Main Boards may not be changed unless re-calibrated.

The Main Board is not a field-repairable component. Replacement Main Boards are pre-tested, programmed, and calibrated.

Power Module

The power module (pn 95612A001) consists of the battery compartment bulkhead and chassis, the fan, cable assemblies, and the Power Supply Board. The Power Supply Board (AC to DC converter) is not a field-repairable component. If the board is damaged or fails test replace the entire board (pn 80232C001).

⚠DANGER⚠

- High Voltage! Repairing and testing the power supply requires working with dangerous voltages. The power supply module should only be serviced by experienced electrical repair technicians.

Fuse Replacement

The main fuses (pn 80131B002) for the power module is located in an external compartment above the AC power cord connection. Replace only with:

- 0.5A/230 volt Slo-Blow fuses (240-volt units).
- 1A/110 volt Slo-Blow fuses (120-volt units).

Check the monitor ID label to determine which voltage the unit uses.

You do not have to open the monitor case to change the main power fuses. See “Fuse Removal/Replacement” on page 5-7.

⚠WARNING⚠

- Shock hazard. Substitution of fuses or jumping the fuse contacts can endanger the patient and damage the monitor.

Fan Replacement

The fan (pn 95619A001) is designed to turn on only when the monitor is warm. The monitor may operate for more than an hour before it becomes warm enough to activate the fan. Much of the heat generated will be due to charging the batteries.

If the bottom rear housing becomes hot to the touch, the fan may not be operating properly. Turn off the CO_2 module to shut off the pump and listen for the fan motor.

The Main Board and a thermal sensor controls the fan. The thermistor wire (pn 90875A001) extends from the Main Board to the power module. The wire is clipped to the Power Supply Board. Check the wire for breaks, damage, or poor connection to the Main Board. The end of the wire should be coated. If the tip is broken replace the wire.

You can test the fan directly with a 5 volt DC source. Replace the fan if necessary. Fan replacement requires you remove the power module.

Power Supply Replacement

The DC output from the power supply enters the Main Board at PS2. Check the cable for breaks or shorting. The AC to DC converter of the power supply should be able to generate 15.6 volts. See “Service Testing and Calibration” in Section 6 for test procedures.

AC Power Components

The power entry assembly (pn 95641A001) is composed of two AC chokes, a ferrite, and power cable connections. The source connections attach directly to the AC receptacle fuse assembly (pn 80124B002).

Replace broken, cracked, or loose AC receptacles. Replace the receptacle if the external pins are bent or broken. Do not attempt to remove or modify the ground pin!

Check the cables and chokes for heat damage before power module replacement. Remove the assembly from the housing and inspect the back side of the board for scorching or damaged solder connections. Replace the entire assembly if there are any signs of high current damage.

Section 9 — Drawings and Schematics

List of Drawings

	Title	Drawing Number
Assembly BOMs and Drawings	O_2 Module Assembly	91354A001
	CO_2 Module Assembly	91355A001
	O_2/Manifold/Resistor Assembly	91765A001
	CO_2 Pneumatics Assembly	91766A001
	O_2/CO_2 Pneumatics Assembly	91767A001
	Front Chassis—Base	92788A001
	Front Chassis—CO_2	92788A003
	Front Chassis—IBP	92788A005
	Front Chassis—CO_2/O_2	92788A011
	Front Chassis—CO_2/IBP	92788A013
	Front Chassis—CO_2/O_2/IBP	92788A025
	Rear Housing Assembly	93258A001
	Front Housing Assembly without CO_2	93259A005
	Front Housing Assembly with CO_2	93259A006
	Final Assembly—2Temp/6Wave	93951A386
	Final Assembly—CO_2/2Temp/6Wave	93951A388
	Final Assembly—IBP/2Temp/6Wave	93951A392
	Final Assembly—CO_2/O_2/2Temp/6Wave	93951A398
	Final Assembly—CO_2/IBP/2Temp/6Wave	93951A402
	Final Assembly—CO_2/O_2/IBP/2Temp/6Wave	93951A420
	Final Assembly—Printer/2Temp/6Wave	93951A674
	Final Assembly—CO_2/2Temp/6Wave	93951A676
	Final Assembly—Printer/IBP/2Temp/6Wave	93951A680
	Final Assembly—Printer/CO_2/O_2/2Temp/6Wave	93951A686
	Final Assembly—Printer/CO2/IBP/2Temp/6Wave	93951A690
	Final Assembly—Printer/CO_2/O_2/IBP/2Temp	93951A708
	NIBP Pump Assembly	94252A001
	Printer Module	95604A002
	Display Assembly	95605A003
	Power Module Assembly	95612A001
	Connector Assembly—Temp/NIBP	95618A001
	Connector Assembly—2IBP/2Temp	95618A004
	Connector Assembly—2IBP/1Temp/NIBP	95618A005
	Connector Assembly—2Temp	95618A006

Pneumatic Assemblies

Title	Drawing Number
(Only on units with the CO_2 or the CO_2/O_2 options)	
Tubing Assembly—O_2	95632A001
Tubing Assembly—CO_2	95632A002
(The above tubing assemblies contain the following subassemblies:)	
PAT Input Tubing	95625A001
Absorber Tubing	95626A001
Pressure Tubing	95627A001
Bleed/Check Tubing	95628A001
O_2 Valve Tubing (Only with pn 95632A001)	95629A001
Valve3, Pump Tubing	95630A001
Valve3, Valve2 Tubing	95631A001
Pump Exhaust	95633A001

PCB Drawings and Schematics

Title	Drawing Number
CO_2 Module PCB	91330A001
O_2 Module PCB	91332A001
SpO_2 PCB	91339A001
SpO_2 PCB Schematic	91339S001
Main PCB	91340A003
Main PCB Schematic	91340S003
Printer Interface PCB	91341A002
Printer Interface PCB Schematic	91341S002
ECG/Analog PCB	91342A002
ECG/Analog PCB Schematic	91342S002
IBP PCB	91350A002
IBP PCB Schematic	91350S002

O_2/CO_2 Assembly

O_2 Module Assembly 91354A001 AY O2 MODULE 8100

Item #	CSI Part #	Description
01	90399A002	AY CABLE 02 SENSOR
02	40995B005	P.H.M.S. 4-40X.25 SEMS
03	91765A001	AY 02 W/ MANIFOLD & RESIS
04	83147B001	FERRITE BD 275OHMS @ 100
05	80078B001	O2 SENSOR
06	42147B001	INSULATOR 02 SENSOR
07	40067B001	CABLE TIE 4.0"LG NYLON
08	40284B001	NUT 4-40 KEPS PL

CO_2 Module Assembly 91355A001 AY 8100 CO2 MODULE

Item #	CSI Part #	Description
01	40995B005	P.H.M.S. 4-40X.25 SEMS
02	41258B002	P.H.M.S.#2-56X.375SEMS PH
03	41457B001	P.H.M.S. 2-56X.25 PL PH
04	42006B001	SPACER .093ID X .188OD X
05	42186B001	STANDOFF 4-40 X .218 HEX
06	42193B001	CO2 SHIELD 8100 MONITOR
07	91330A001	AY CO2 PCB 8100
08	95611A001	AY 8100 CO2 BENCH
10	41188C201	CO2 DETECTOR
11	83304B001	GASKET DETECTOR/IR SOURCE

O_2/Manifold/Resistor Assembly 91765A001 8100 O2 MANIFOLD AY

Item #	CSI Part #	Description
01	10023B003	RESISTOR 30 OHM 1W 5%
02	40298B001	ADHESIVE STYCAST/CATALYST
03	40995B005	P.H.M.S. 4-40X.25 SEMS
04	42062B003	TUBING SSTL .083OD X .75L
05	42146B001	MANIFOLD 02 SENSOR
06	80059B001	THERMISTOR 10K@25C
07	91332A001	8100 O2 BOARD

CO_2 Pneumatics Assembly 91766A001 AY C02 8100

Item #	CSI Part #	Description
01	91355A001	AY 8100 CO2 MODULE
02	95632A002	AY 8100 TUBE SET (NO O2)

O_2/CO_2 Pneumatics Assembly 91767A001 AY O2/CO2 8100

Item #	CSI Part #	Description
01	91355A001	AY 8100 CO2 MODULE
02	91354A001	AY O2 MODULE 8100
03	95632A001	AY 8100 TUBING SET (W/02)

Front Chassis Assemblies

Front Chassis—Base 92788A001 CHASIS FRNT 8100 BASE

Item #	CSI Part #	Description
02	42131B001	CHASSIS FRONT
03	40496B002	P.H.M.S. 6-32X.250 SEMS
04	94252A001	AY 8100 NIBP PUMP
05	40995B005	P.H.M.S. 4-40X.25 SEMS
07	83311B001	INSULATOR FRONT CHASSIS
08	42211B001	INSULATOR CHASSIS BACK
09	40294B001	HOLDER TIE WRAP ADH-BK SM
10	41602B001	TUBING POLYU .188 X .3125
11	40067B001	CABLE TIE 4.0”LG NYLON
16	40909B001	SPACER HEX 6-32X.5 NY M/F
17	90866A001	SPO2 TO ANALOG BOARD CBL
18	82515B001	SPLIT FLAT CBL SUPP CORE
19	41955B001	FOAM TAPE 1.0 X 2.12
20	95624A001	AY CBL SPO2 TO DB9
24	42212B002	CABLE SUPPORT CO2 MAIN
28	91339A001	AY PCB 8100 SPO2 BRD
30	42228B002	SHIELD SPO2 ANALOG CBL
31	42230B002	INSULATING BUSHING
32	40041B009	TUBING SHRINK .375 CLR
37	40683B001	TAPE TRANSFER ADH 5MIL
38	40067B002	CABLE TIE 5.5”LG NYLON

Front Chassis—CO_2 92788A003 CHASSIS FRNT 8100 CO2

Item #	CSI Part #	Description
01	94253A001	BTC PUMP/MOTOR AY
02	42131B001	CHASSIS FRONT
03	40496B002	P.H.M.S. 6-32X.250 SEMS
04	94252A001	AY 8100 NIBP PUMP
05	40995B005	P.H.M.S. 4-40X.25 SEMS
06	42189C001	STNDOF M 4-40 X 1.312 HEX
07	83311B001	INSULATOR FRONT CHASSIS
08	42211B001	INSULATOR CHASSIS BACK
09	40294B001	HOLDER TIE WRAP ADH-BK SM
10	41602B001	TUBING POLYU .188 X .3125
11	40067B001	CABLE TIE 4.0"LG NYLON
15	87225B001	CBL 2MM PITCH RIBBON
16	40909B001	SPACER HEX 6-32X.5 NY M/F
17	90866A001	SPO2 TO ANALOG BOARD CBL
18	82515B001	SPLIT FLAT CBL SUPP CORE
19	41955B001	FOAM TAPE 1.0 X 2.12
20	95624A001	AY CBL SPO2 TO DB9
24	42212B002	CABLE SUPPORT CO2 MAIN
28	91339A001	AY PCB 8100 SPO2 BRD
29	91766A001	AY C02 8100
30	42228B002	SHIELD SPO2 ANALOG CBL
31	42230B002	INSULATING BUSHING
32	40041B009	TUBING SHRINK .375 CLR
37	40683B001	TAPE TRANSFER ADH 5MIL
38	40067B002	CABLE TIE 5.5"LG NYLON
39	40041B001	TUBING SHRINK .250 CLR

Front Chassis—IBP 92788A005 CHASSIS FRNT 8100 IBP

Item #	CSI Part #	Description
02	42131B001	CHASSIS FRONT
03	40496B002	P.H.M.S. 6-32X.250 SEMS
04	94252A001	AY 8100 NIBP PUMP
05	40995B005	P.H.M.S. 4-40X.25 SEMS
07	83311B001	INSULATOR FRONT CHASSIS
08	42211B001	INSULATOR CHASSIS BACK
09	40294B001	HOLDER TIE WRAP ADH-BK SM
10	41602B001	TUBING POLYU .188 X .3125
11	40067B001	CABLE TIE 4.0"LG NYLON
16	40909B001	SPACER HEX 6-32X.5 NY M/F
17	90866A001	SPO2 TO ANALOG BOARD CBL
18	82515B001	SPLIT FLAT CBL SUPP CORE
19	41955B001	FOAM TAPE 1.0 X 2.12
20	95624A001	AY CBL SPO2 TO DB9
24	42212B002	CABLE SUPPORT CO2 MAIN
28	91339A001	AY PCB 8100 SPO2 BRD
30	42228B002	SHIELD SPO2 ANALOG CBL
31	42230B002	INSULATING BUSHING
32	40041B009	TUBING SHRINK .375 CLR
33	42187C001	STANDOFF MODIFIED
35	91350A002	AY IBP BRD
36	83352B001	CBL 2MM IDC STRIPS
37	40683B001	TAPE TRANSFER ADH 5MIL
38	40067B002	CABLE TIE 5.5"LG NYLON

Front Chassis—CO_2/O_2 92788A011 CHASIS FRNT 8100 CO2/O2

Item #	CSI Part #	Description
01	94253A001	BTC PUMP/MOTOR AY
02	42131B001	CHASSIS FRONT
03	40496B002	P.H.M.S. 6-32X.250 SEMS
04	94252A001	AY 8100 NIBP PUMP
05	40995B005	P.H.M.S. 4-40X.25 SEMS
06	42189C001	STNDOF M 4-40 X 1.312 HEX
07	83311B001	INSULATOR FRONT CHASSIS
08	42211B001	INSULATOR CHASSIS BACK
09	40294B001	HOLDER TIE WRAP ADH-BK SM
10	41602B001	TUBING POLYU .188 X .3125
11	40067B001	CABLE TIE 4.0”LG NYLON
15	87225B001	CBL 2MM PITCH RIBBON
16	40909B001	SPACER HEX 6-32X.5 NY M/F
17	90866A001	SPO2 TO ANALOG BOARD CBL
18	82515B001	SPLIT FLAT CBL SUPP CORE
19	41955B001	FOAM TAPE 1.0 X 2.12
20	95624A001	AY CBL SPO2 TO DB9
24	42212B002	CABLE SUPPORT CO2 MAIN
28	91339A001	AY PCB 8100 SPO2 BRD
29	91767A001	AY O2/C02 8100
30	42228B002	SHIELD SPO2 ANALOG CBL
31	42230B002	INSULATING BUSHING
32	40041B009	TUBING SHRINK .375 CLR
37	40683B001	TAPE TRANSFER ADH 5MIL
38	40067B002	CABLE TIE 5.5”LG NYLON

Front Chassis—CO_2/IBP 92788A013 CHASSIS FRNT 8100 CO2 IBP

Item #	CSI Part #	Description
01	94253A001	BTC PUMP/MOTOR AY
02	42131B001	CHASSIS FRONT
03	40496B002	P.H.M.S. 6-32X.250 SEMS
04	94252A001	AY 8100 NIBP PUMP
05	40995B005	P.H.M.S. 4-40X.25 SEMS
06	42189C001	STNDOF M 4-40 X 1.312 HEX
07	83311B001	INSULATOR FRONT CHASSIS
08	42211B001	INSULATOR CHASSIS BACK
09	40294B001	HOLDER TIE WRAP ADH-BK SM
10	41602B001	TUBING POLYU .188 X .3125
11	40067B001	CABLE TIE 4.0"LG NYLON
15	87225B001	CBL 2MM PITCH RIBBON
16	40909B001	SPACER HEX 6-32X.5 NY M/F
17	90866A001	SPO2 TO ANALOG BOARD CBL
18	82515B001	SPLIT FLAT CBL SUPP CORE
19	41955B001	FOAM TAPE 1.0 X 2.12
20	95624A001	AY CBL SPO2 TO DB9
24	42212B002	CABLE SUPPORT CO2 MAIN
28	91339A001	AY PCB 8100 SPO2 BRD
29	91766A001	AY C02 8100
30	42228B002	SHIELD SPO2 ANALOG CBL
31	42230B002	INSULATING BUSHING
32	40041B009	TUBING SHRINK .375 CLR
33	42187C001	STANDOFF MODIFIED
34	42188B001	STANDOFF.25 4-40 X .812LG
35	91350A002	AY IBP BRD
36	83352B001	CBL 2MM IDC STRIPS
37	40683B001	TAPE TRANSFER ADH 5MIL
38	40067B002	CABLE TIE 5.5"LG NYLON
39	40041B001	TUBING SHRINK .250 CLR

Front Chassis—CO_2/O_2/ IBP

92788A025 CHASSIS 8100 CO2/02 IBP

Item #	CSI Part #	Description
01	94253A001	BTC PUMP/MOTOR AY
02	42131B001	CHASSIS FRONT
03	40496B002	P.H.M.S. 6-32X.250 SEMS
04	94252A001	AY 8100 NIBP PUMP
05	40995B005	P.H.M.S. 4-40X.25 SEMS
06	42189C001	STNDOF M 4-40 X 1.312 HEX
07	83311B001	INSULATOR FRONT CHASSIS
08	42211B001	INSULATOR CHASSIS BACK
09	40294B001	HOLDER TIE WRAP ADH-BK SM
10	41602B001	TUBING POLYU .188 X .3125
11	40067B001	CABLE TIE 4.0"LG NYLON
15	87225B001	CBL 2MM PITCH RIBBON
16	40909B001	SPACER HEX 6-32X.5 NY M/F
17	90866A001	SPO2 TO ANALOG BOARD CBL
18	82515B001	SPLIT FLAT CBL SUPP CORE
19	41955B001	FOAM TAPE 1.0 X 2.12
20	95624A001	AY CBL SPO2 TO DB9
24	42212B002	CABLE SUPPORT CO2 MAIN
28	91339A001	AY PCB 8100 SPO2 BRD
29	91767A001	AY O2/C02 8100
30	42228B002	SHIELD SPO2 ANALOG CBL
31	42230B002	INSULATING BUSHING
32	40041B009	TUBING SHRINK .375 CLR
33	42187C001	STANDOFF MODIFIED
33	42188B001	STANDOFF.25 4-40 X .812LG
35	91350A002	AY IBP BRD
36	83352B001	CBL 2MM IDC STRIPS
38	40067B002	CABLE TIE 5.5"LG NYLON

Rear Housing Assembly

93258A001 AY HOUSING REAR 8100

Item #	CSI Part #	Description
01	45112B001	HOUSING REAR
03	42129B001	BATTERY DOOR
04	42130B001	HINGE BATTERY DOOR
05	42144B001	BATTERY DOOR PIN
10	83267B001	BED RAIL HOOK
11	42170B001	BRKT BED RAIL HOOK
12	42173B001	STANDOFF .188X .141 .875L
15	80124B002	PWR RECEPT/FUSE MODULE
16	80130B001	PWR RECPT/FUSE DRAWER
18	41158B001	TERMINAL EQUIPOTENTIAL
20	95257A001	AY SPEAKER 8100
21	95645A001	AY INSUL SPKER RETAINER
24	83302B001	#4 ROUND RUBBER FOOT
26	95641A001	AY POWER ENTRY
27	42206B004	INSULATOR PWR ENTRY BRD
29	90883A001	AY CBL MULTIPLE GROUND
31	42205B001	INSULATOR BATT TERMINAL
32	83340B001	DRIP SHIELD FRONT SNAPS
34	83339B002	DRIP GUARD PRINTER DECK
35	42210B004	INSULATOR BENCH AC INLET
36	42223B001	FOAM GASKT LOW O2 SEN DOR
37	42223B002	FOAM GASKT SIDEO2 SEN DOR
40	40995B005	P.H.M.S. 4-40X.25 SEMS
41	40123B003	P.H.M.S. 4-40X.375 NY WHT
42	40995B003	P.H.M.S. 4-40X.500 SEMS
43	42065B002	F.H.M.S 4-40 X.250 PH PNT
44	42064B004	F.H.M.S. 4-40X.375 PH PL
45	40878B001	H.H.M.S. 6-32X1.25 PL
48	40284B001	NUT 4-40 KEPS PL
49	41164B001	NUT M6 X 1.0 KEPS PL
52	40086B003	WASHER FLAT PL .156X.375
53	40007B002	WASHER LOCK #6 EXT TOOTH
54	42222B007	1/4 INTRNL TOOTH LCK WSHR
56	83111B002	8100 PRINTER CBL
57	41955B001	FOAM TAPE 1.0 X 2.12
59	80131B002	FUSE 250V 1 AMP SB

Front Housing Assemblies

Front Housing Assembly without CO_2

93259A005 HOUSING FRONT AY 8100 ACT

Item #	CSI Part #	Description
01	45113B001	HOUSING FRONT
02	95605A003	AY DISPLAY 10.4 NEC
03	95638A001	CBL FRNT HOUS TO MAIN BRD
04	45115B001	COVER WATER TRAP OPENING
07	42141B001	KNOB ROTARY ENCODER CUSTM
10	45116B001	MEMBRANE SWITCH 8100
12	42140B001	ROTARY ENCODER
15	46211B001	LABEL NO CO2
19	40284B005	NUT 10-32 KEPS PL
20	40995B005	P.H.M.S. 4-40X.25 SEMS
22	41371B001	TAPE INSUL KAPTON 2" WIDE

Front Housing Assembly with CO_2

93259A006 FRONT FRONT AY 8100 ACT

Item #	CSI Part #	Description
01	45113B001	HOUSING FRONT
02	95605A003	AY DISPLAY 10.4 NEC
03	95638A001	CBL FRNT HOUS TO MAIN BRD
05	42177B001	COVER WATER TRAP MANIFOLD
07	42141B001	KNOB ROTARY ENCODER CUSTM
10	45116B001	MEMBRANE SWITCH 8100
12	42140B001	ROTARY ENCODER
14	42270B002	WATER TRAP MANIFOLD
19	40284B005	NUT 10-32 KEPS PL
20	40995B005	P.H.M.S. 4-40X.25 SEMS
21	40297B002	TUBING,SLCN .093IDX.390OD
22	41371B001	TAPE INSUL KAPTON 2" WIDE

Final Assemblies

Final Assembly— 2Temp/6Wave

93951A386 8100 FNL BASE 2 TEMP/6W

Item #	CSI Part #	Description
01	93258A001	AY HOUSING REAR 8100
03	93259A005	HOUSING FRONT AY 8100 ACT
05	92788A001	CHASSIS FRONT 8100 BASE
07	95612A001	AY POWER MODULE
09	91340A003	AY PCB 8100 MAIN BRD
10	91353A002	AY SHIELDED ANALOG BRD
12	95618A006	CONN AY 2 TEMP
15	90871A002	AY CBL ECG ANALOG TO OUT
17	45114B001	COVER PRINTER OPENING
19	41891B001	DB9 COVER PLATE
21	42225B001	SUPPORT FRONT PLASTIC
22	42227B001	RICHCO WIRE CLIP
25	40284B001	NUT 4-40 KEPS PL
26	40284B002	NUT 6-32 KEPS PL
27	42065B004	F.H.M.S. 4-40 X.375 PH PL
28	40995B001	P.H.M.S. 4-40X.312 SEMS
29	40995B006	P.H.M.S. 4-40X.38 SEMS
33	40496B001	P.H.M.S. 6-32X.375 SEMS
35	40876B001	P.H.M.S. 8-32X.25 PL SEMS
36	40873B004	P.H.M.S. 8-32X.750 PL PH
38	42175B001	STANDOFF .632X.625 .25HEX
40	83278B001	BATTERY 8100
44	46220B001	LBL SERIAL # 8100
45	42220B001	LBLS LASER 5167 SHEET
46	40909B002	SPCR HEX 6-32X.625 NY M/F
47	40496B006	P.H.M.S. 6-32X..43 SEMS
48	42132B001	ACCESS DOOR O2 SENSOR
49	42134B003	CONN MNT PLT 2TEMP
50	42014B001	FITNG, QUICK CON. HH NIBP
51	40284B005	NUT 10-32 KEPS PL
52	83375B001	COVER CAN CONNECTOR 8100
53	40995B005	P.H.M.S. 4-40X.25 SEMS
60	40873B001	P.H.M.S. 8-32X.375 PL PH

Final Assembly— CO_2/2Temp/6Wave

93951A388 8100 FNL CO2 2T/6WAVE

Item #	CSI Part #	Description
01	93258A001	AY HOUSING REAR 8100
03	93259A006	HOUSING FRONT AY 8100 ACT
05	92788A003	CHASSIS FRNT 8100 CO2
07	95612A001	AY POWER MODULE
09	91340A003	AY PCB 8100 MAIN BRD
10	91353A002	AY SHIELDED ANALOG BRD
12	95618A006	CONN AY 2 TEMP
15	90871A002	AY CBL ECG ANALOG TO OUT
17	45114B001	COVER PRINTER OPENING
19	41891B001	DB9 COVER PLATE
21	42225B001	SUPPORT FRONT PLASTIC
22	42227B001	RICHCO WIRE CLIP
25	40284B001	NUT 4-40 KEPS PL
26	40284B002	NUT 6-32 KEPS PL
27	42065B004	F.H.M.S. 4-40 X.375 PH PL
28	40995B001	P.H.M.S. 4-40X.312 SEMS
29	40995B006	P.H.M.S. 4-40X.38 SEMS
33	40496B001	P.H.M.S. 6-32X.375 SEMS
35	40876B001	P.H.M.S. 8-32X.25 PL SEMS
36	40873B004	P.H.M.S. 8-32X.750 PL PH
38	42175B001	STANDOFF .632X.625 .25HEX
40	83278B001	BATTERY 8100
44	46220B001	LBL SERIAL # 8100
45	42220B001	LBLS LASER 5167 SHEET
46	40909B002	SPCR HEX 6-32X.625 NY M/F
47	40496B006	P.H.M.S. 6-32X..43 SEMS
48	42132B001	ACCESS DOOR O2 SENSOR
49	42134B003	CONN MNT PLT 2TEMP
50	42014B001	FITNG, QUICK CON. HH NIBP
51	40284B005	NUT 10-32 KEPS PL
52	83375B001	COVER CAN CONNECTOR 8100
53	40995B005	P.H.M.S. 4-40X.25 SEMS
57	40067B003	CABLE TIE 8" LG NYLON
60	40873B001	P.H.M.S. 8-32X.375 PL PH

Final Assembly— IBP/2Temp/6Wave

93951A392 8100 AY IBP/2T/6WAVE

Item #	CSI Part #	Description
01	93258A001	AY HOUSING REAR 8100
03	93259A005	HOUSING FRONT AY 8100 ACT
05	92788A005	CHASSIS FRNT 8100 IBP
07	95612A001	AY POWER MODULE
09	91340A003	AY PCB 8100 MAIN BRD
10	91353A002	AY SHIELDED ANALOG BRD
12	95618A004	CONN AY 2 IBP/2 TEMP/NIBP
15	90871A002	AY CBL ECG ANALOG TO OUT
17	45114B001	COVER PRINTER OPENING
19	41891B001	DB9 COVER PLATE
21	42225B001	SUPPORT FRONT PLASTIC
22	42227B001	RICHCO WIRE CLIP
25	40284B001	NUT 4-40 KEPS PL
26	40284B002	NUT 6-32 KEPS PL
27	42065B004	F.H.M.S. 4-40 X.375 PH PL
28	40995B001	P.H.M.S. 4-40X.312 SEMS
29	40995B006	P.H.M.S. 4-40X.38 SEMS
33	40496B001	P.H.M.S. 6-32X.375 SEMS
35	40876B001	P.H.M.S. 8-32X.25 PL SEMS
36	40873B004	P.H.M.S. 8-32X.750 PL PH
38	42175B001	STANDOFF .632X.625 .25HEX
40	83278B001	BATTERY 8100
44	46220B001	LBL SERIAL # 8100
45	42220B001	LBLS LASER 5167 SHEET
46	40909B002	SPCR HEX 6-32X.625 NY M/F
47	40496B006	P.H.M.S. 6-32X..43 SEMS
48	42132B001	ACCESS DOOR O2 SENSOR
50	42014B001	FITNG, QUICK CON. HH NIBP
51	40284B005	NUT 10-32 KEPS PL
52	83375B001	COVER CAN CONNECTOR 8100
53	40995B005	P.H.M.S. 4-40X.25 SEMS
60	40873B001	P.H.M.S. 8-32X.375 PL PH

Final Assembly— $CO_2/O_2/2Temp/6Wave$ 93951A398 8100 FNL CO2/O2/2T/6WAVE

Item #	CSI Part #	Description
01	93258A001	AY HOUSING REAR 8100
03	93259A006	HOUSING FRONT AY 8100 ACT
07	95612A001	AY POWER MODULE
09	91340A003	AY PCB 8100 MAIN BRD
10	91353A002	AY SHIELDED ANALOG BRD
10	92788A011	CHASSIS FRNT 8100 CO2/02
12	95618A006	CONN AY 2 TEMP
15	90871A002	AY CBL ECG ANALOG TO OUT
17	45114B001	COVER PRINTER OPENING
19	41891B001	DB9 COVER PLATE
21	42225B001	SUPPORT FRONT PLASTIC
22	42227B001	RICHCO WIRE CLIP
25	40284B001	NUT 4-40 KEPS PL
26	40284B002	NUT 6-32 KEPS PL
27	42065B004	F.H.M.S. 4-40 X.375 PH PL
28	40995B001	P.H.M.S. 4-40X.312 SEMS
29	40995B006	P.H.M.S. 4-40X.38 SEMS
33	40496B001	P.H.M.S. 6-32X.375 SEMS
35	40876B001	P.H.M.S. 8-32X.25 PL SEMS
36	40873B004	P.H.M.S. 8-32X.750 PL PH
38	42175B001	STANDOFF .632X.625 .25HEX
40	83278B001	BATTERY 8100
44	46220B001	LBL SERIAL # 8100
45	42220B001	LBLS LASER 5167 SHEET
46	40909B002	SPCR HEX 6-32X.625 NY M/F
47	40496B006	P.H.M.S. 6-32X..43 SEMS
48	42132B001	ACCESS DOOR O2 SENSOR
49	42134B003	CONN MNT PLT 2TEMP
50	42014B001	FITNG, QUICK CON. HH NIBP
51	40284B005	NUT 10-32 KEPS PL
52	83375B001	COVER CAN CONNECTOR 8100
53	40995B005	P.H.M.S. 4-40X.25 SEMS
57	40067B003	CABLE TIE 8” LG NYLON
60	40873B001	P.H.M.S. 8-32X.375 PL PH

Final Assembly— CO_2/IBP/2Temp/6Wave

93951A402 8100 CO2/IBP/2T/6WAVE

Item #	CSI Part #	Description
01	93258A001	AY HOUSING REAR 8100
03	93259A006	HOUSING FRONT AY 8100 ACT
05	92788A013	CHASSIS FRNT 8100 CO2 IBP
07	95612A001	AY POWER MODULE
09	91340A003	AY PCB 8100 MAIN BRD
10	91353A002	AY SHIELDED ANALOG BRD
12	95618A004	CONN AY 2 IBP/2 TEMP/NIBP
15	90871A002	AY CBL ECG ANALOG TO OUT
17	45114B001	COVER PRINTER OPENING
19	41891B001	DB9 COVER PLATE
21	42225B001	SUPPORT FRONT PLASTIC
22	42227B001	RICHCO WIRE CLIP
25	40284B001	NUT 4-40 KEPS PL
26	40284B002	NUT 6-32 KEPS PL
27	42065B004	F.H.M.S. 4-40 X.375 PH PL
28	40995B001	P.H.M.S. 4-40X.312 SEMS
29	40995B006	P.H.M.S. 4-40X.38 SEMS
35	40876B001	P.H.M.S. 8-32X.25 PL SEMS
36	40873B004	P.H.M.S. 8-32X.750 PL PH
38	42175B001	STANDOFF .632X.625 .25HEX
40	83278B001	BATTERY 8100
44	46220B001	LBL SERIAL # 8100
45	42220B001	LBLS LASER 5167 SHEET
46	40909B002	SPCR HEX 6-32X.625 NY M/F
47	40496B006	P.H.M.S. 6-32X..43 SEMS
48	42132B001	ACCESS DOOR O2 SENSOR
50	42014B001	FITNG, QUICK CON. HH NIBP
51	40284B005	NUT 10-32 KEPS PL
52	83375B001	COVER CAN CONNECTOR 8100
53	40995B005	P.H.M.S. 4-40X.25 SEMS
57	40067B003	CABLE TIE 8" LG NYLON
60	40873B001	P.H.M.S. 8-32X.375 PL PH

Final Assembly— CO_2/O_2/IBP/2Temp/6Wave

93951A420 8100 CO2/O2/IBP/2T/6 WAVE

Item #	CSI Part #	Description
01	93258A001	AY HOUSING REAR 8100
03	93259A006	HOUSING FRONT AY 8100 ACT
05	92788A025	CHASSIS 8100 CO2/02 IBP
07	95612A001	AY POWER MODULE
09	91340A003	AY PCB 8100 MAIN BRD
10	91353A002	AY SHIELDED ANALOG BRD
12	95618A004	CONN AY 2 IBP/2 TEMP/NIBP
15	90871A002	AY CBL ECG ANALOG TO OUT
17	45114B001	COVER PRINTER OPENING
19	41891B001	DB9 COVER PLATE
21	42225B001	SUPPORT FRONT PLASTIC
22	42227B001	RICHCO WIRE CLIP
25	40284B001	NUT 4-40 KEPS PL
26	40284B002	NUT 6-32 KEPS PL
27	42065B004	F.H.M.S. 4-40 X.375 PH PL
28	40995B001	P.H.M.S. 4-40X.312 SEMS
29	40996B006	P.H.M.S. 4-40X.38 SEMS
33	40496B001	P.H.M.S. 6-32X.375 SEMS
35	40876B001	P.H.M.S. 8-32X.25 PL SEMS
36	40873B004	P.H.M.S. 8-32X.750 PL PH
38	42175B001	STANDOFF .632X.625 .25HEX
40	83278B001	BATTERY 8100
44	46220B001	LBL SERIAL # 8100
45	42220B001	LBLS LASER 5167 SHEET
46	40909B002	SPCR HEX 6-32X.625 NY M/F
47	40496B006	P.H.M.S. 6-32X..43 SEMS
48	42132B001	ACCESS DOOR O2 SENSOR
50	42014B001	FITNG, QUICK CON. HH NIBP
51	40284B005	NUT 10-32 KEPS PL
52	83375B001	COVER CAN CONNECTOR 8100
53	40995B005	P.H.M.S. 4-40X.25 SEMS
57	40067B003	CABLE TIE 8" LG NYLON
60	40873B001	P.H.M.S. 8-32X.375 PL PH

Final Assembly—Printer/2Temp/6Wave

93951A674 8100 FNL PRNTR 2T/6WAVE

Item #	CSI Part #	Description
01	93258A001	AY HOUSING REAR 8100
03	93259A005	HOUSING FRONT AY 8100 ACT
05	92788A001	CHASSIS FRONT 8100 BASE
07	95612A001	AY POWER MODULE
09	91340A003	AY PCB 8100 MAIN BRD
10	91353A002	AY SHIELDED ANALOG BRD
12	95618A006	CONN AY 2 TEMP
15	90871A002	AY CBL ECG ANALOG TO OUT
18	95604A002	PRINTER MODULE 8100/9100
19	41891B001	DB9 COVER PLATE
21	42225B001	SUPPORT FRONT PLASTIC
22	42227B001	RICHCO WIRE CLIP
25	40284B001	NUT 4-40 KEPS PL
26	40284B002	NUT 6-32 KEPS PL
27	42065B004	F.H.M.S. 4-40 X.375 PH PL
28	40995B001	P.H.M.S. 4-40X.312 SEMS
29	40995B006	P.H.M.S. 4-40X.38 SEMS
33	40496B001	P.H.M.S. 6-32X.375 SEMS
35	40876B001	P.H.M.S. 8-32X.25 PL SEMS
36	40873B004	P.H.M.S. 8-32X.750 PL PH
38	42175B001	STANDOFF .632X.625 .25HEX
40	83278B001	BATTERY 8100
44	46220B001	LBL SERIAL # 8100
45	42220B001	LBLS LASER 5167 SHEET
46	40909B002	SPCR HEX 6-32X.625 NY M/F
47	40496B006	P.H.M.S. 6-32X..43 SEMS
48	42132B001	ACCESS DOOR O2 SENSOR
49	42134B003	CONN MNT PLT 2TEMP
50	42014B001	FITNG, QUICK CON. HH NIBP
51	40284B005	NUT 10-32 KEPS PL
52	83375B001	COVER CAN CONNECTOR 8100
53	40995B005	P.H.M.S. 4-40X.25 SEMS
60	40873B001	P.H.M.S. 8-32X.375 PL PH

Final Assembly— CO_2/2Temp/6Wave

93951A676 8100 FNL CO2/2T/6WAVE

Item #	CSI Part #	Description
01	93258A001	AY HOUSING REAR 8100
03	93259A006	HOUSING FRONT AY 8100 ACT
05	92788A003	CHASSIS FRNT 8100 CO2
07	95612A001	AY POWER MODULE
09	91340A003	AY PCB 8100 MAIN BRD
10	91353A002	AY SHIELDED ANALOG BRD
12	95618A006	CONN AY 2 TEMP
15	90871A002	AY CBL ECG ANALOG TO OUT
18	95604A002	PRINTER MODULE 8100/9100
19	41891B001	DB9 COVER PLATE
21	42225B001	SUPPORT FRONT PLASTIC
22	42227B001	RICHCO WIRE CLIP
25	40284B001	NUT 4-40 KEPS PL
26	40284B002	NUT 6-32 KEPS PL
27	42065B004	F.H.M.S. 4-40 X.375 PH PL
28	40995B001	P.H.M.S. 4-40X.312 SEMS
29	40995B006	P.H.M.S. 4-40X.38 SEMS
33	40496B001	P.H.M.S. 6-32X.375 SEMS
35	40876B001	P.H.M.S. 8-32X.25 PL SEMS
36	40873B004	P.H.M.S. 8-32X.750 PL PH
38	42175B001	STANDOFF .632X.625 .25HEX
40	83278B001	BATTERY 8100
44	46220B001	LBL SERIAL # 8100
45	42220B001	LBLS LASER 5167 SHEET
46	40909B002	SPCR HEX 6-32X.625 NY M/F
47	40496B006	P.H.M.S. 6-32X..43 SEMS
48	42132B001	ACCESS DOOR O2 SENSOR
49	42134B003	CONN MNT PLT 2TEMP
50	42014B001	FITNG, QUICK CON. HH NIBP
51	40284B005	NUT 10-32 KEPS PL
52	83375B001	COVER CAN CONNECTOR 8100
53	40995B005	P.H.M.S. 4-40X.25 SEMS
57	40067B003	CABLE TIE 8" LG NYLON
60	40873B001	P.H.M.S. 8-32X.375 PL PH

Final Assembly— Printer/IBP/2Temp/6Wave

93951A680 8100 PRNTR/IBP/2T/6WAVE

Item #	CSI Part #	Description
01	93258A001	AY HOUSING REAR 8100
03	93259A005	HOUSING FRONT AY 8100 ACT
05	92788A005	CHASSIS FRNT 8100 IBP
07	95612A001	AY POWER MODULE
09	91340A003	AY PCB 8100 MAIN BRD
10	91353A002	AY SHIELDED ANALOG BRD
12	95618A004	CONN AY 2 IBP/2 TEMP/NIBP
15	90871A002	AY CBL ECG ANALOG TO OUT
18	95604A002	PRINTER MODULE 8100/9100
19	41891B001	DB9 COVER PLATE
21	42225B001	SUPPORT FRONT PLASTIC
22	42227B001	RICHCO WIRE CLIP
25	40284B001	NUT 4-40 KEPS PL
26	40284B002	NUT 6-32 KEPS PL
27	42065B004	F.H.M.S. 4-40 X.375 PH PL
28	40995B001	P.H.M.S. 4-40X.312 SEMS
29	40995B006	P.H.M.S. 4-40X.38 SEMS
33	40496B001	P.H.M.S. 6-32X.375 SEMS
35	40876B001	P.H.M.S. 8-32X.25 PL SEMS
36	40873B004	P.H.M.S. 8-32X.750 PL PH
38	42175B001	STANDOFF .632X.625 .25HEX
40	83278B001	BATTERY 8100
46	40909B002	SPCR HEX 6-32X.625 NY M/F
47	40496B006	P.H.M.S. 6-32X..43 SEMS
48	42132B001	ACCESS DOOR O2 SENSOR
50	42014B001	FITNG, QUICK CON. HH NIBP
51	40284B005	NUT 10-32 KEPS PL
52	83375B001	COVER CAN CONNECTOR 8100
53	40995B005	P.H.M.S. 4-40X.25 SEMS
60	40873B001	P.H.M.S. 8-32X.375 PL PH

Final Assembly— Printer/CO_2/O_2/ 2Temp/6Wave

93951A686 8100 FNL CO2/O2/2T/6WAVE

Item #	CSI Part #	Description
01	93258A001	AY HOUSING REAR 8100
03	93259A006	HOUSING FRONT AY 8100 ACT
05	92788A011	CHASSIS FRNT 8100 CO2/02
07	95612A001	AY POWER MODULE
09	91340A003	AY PCB 8100 MAIN BRD
10	91353A002	AY SHIELDED ANALOG BRD
12	95618A006	CONN AY 2 TEMP
15	90871A002	AY CBL ECG ANALOG TO OUT
18	95604A002	PRINTER MODULE 8100/9100
19	41891B001	DB9 COVER PLATE
21	42225B001	SUPPORT FRONT PLASTIC
22	42227B001	RICHCO WIRE CLIP
25	40284B001	NUT 4-40 KEPS PL
26	40284B002	NUT 6-32 KEPS PL
27	42065B004	F.H.M.S. 4-40 X.375 PH PL
28	40995B001	P.H.M.S. 4-40X.312 SEMS
29	40995B006	P.H.M.S. 4-40X.38 SEMS
33	40496B001	P.H.M.S. 6-32X.375 SEMS
35	40876B001	P.H.M.S. 8-32X.25 PL SEMS
36	40873B004	P.H.M.S. 8-32X.750 PL PH
38	42175B001	STANDOFF .632X.625 .25HEX
40	83278B001	BATTERY 8100
46	40909B002	SPCR HEX 6-32X.625 NY M/F
47	40496B006	P.H.M.S. 6-32X..43 SEMS
48	42132B001	ACCESS DOOR O2 SENSOR
49	42134B003	CONN MNT PLT 2TEMP
50	42014B001	FITNG, QUICK CON. HH NIBP
51	40284B005	NUT 10-32 KEPS PL
52	83375B001	COVER CAN CONNECTOR 8100
53	40995B005	P.H.M.S. 4-40X.25 SEMS
57	40067B003	CABLE TIE 8" LG NYLON
60	40873B001	P.H.M.S. 8-32X.375 PL PH

Final Assembly— Printer/CO_2/IBP/2Temp/6Wave

93951A690 8100 CO2/PRNTR/IBP/2T/6W

Item #	CSI Part #	Description
01	93258A001	AY HOUSING REAR 8100
03	93259A006	HOUSING FRONT AY 8100 ACT
05	92788A013	CHASSIS FRNT 8100 CO2 IBP
07	95612A001	AY POWER MODULE
09	91340A003	AY PCB 8100 MAIN BRD
10	91353A002	AY SHIELDED ANALOG BRD
12	95618A004	CONN AY 2 IBP/2 TEMP/NIBP
15	90871A002	AY CBL ECG ANALOG TO OUT
18	95604A002	PRINTER MODULE 8100/9100
19	41891B001	DB9 COVER PLATE
21	42225B001	SUPPORT FRONT PLASTIC
22	42227B001	RICHCO WIRE CLIP
25	40284B001	NUT 4-40 KEPS PL
26	40284B002	NUT 6-32 KEPS PL
27	42065B004	F.H.M.S. 4-40 X.375 PH PL
28	40995B001	P.H.M.S. 4-40X.312 SEMS
29	40995B006	P.H.M.S. 4-40X.38 SEMS
33	40496B001	P.H.M.S. 6-32X.375 SEMS
35	40876B001	P.H.M.S. 8-32X.25 PL SEMS
36	40873B004	P.H.M.S. 8-32X.750 PL PH
38	42175B001	STANDOFF .632X.625 .25HEX
40	83278B001	BATTERY 8100
44	46220B001	LBL SERIAL # 8100
45	42220B001	LBLS LASER 5167 SHEET
46	40909B002	SPCR HEX 6-32X.625 NY M/F
47	40496B006	P.H.M.S. 6-32X..43 SEMS
48	42132B001	ACCESS DOOR O2 SENSOR
50	42014B001	FITNG, QUICK CON. HH NIBP
51	40284B005	NUT 10-32 KEPS PL
52	83375B001	COVER CAN CONNECTOR 8100
53	40995B005	P.H.M.S. 4-40X.25 SEMS
57	40067B003	CABLE TIE 8" LG NYLON
60	40873B001	P.H.M.S. 8-32X.375 PL PH

Final Assembly— Printer/CO_2/O_2/IBP/2Temp

93951A708 8100FNL 8100 PRNTR/CO2/O2/IBP/2T

Item #	CSI Part #	Description
01	93258A001	AY HOUSING REAR 8100
03	93259A006	HOUSING FRONT AY 8100 ACT
05	92788A025	CHASSIS 8100 CO2/02 IBP
07	95612A001	AY POWER MODULE
09	91340A003	AY PCB 8100 MAIN BRD
10	91353A002	AY SHIELDED ANALOG BRD
12	95618A004	CONN AY 2 IBP/2 TEMP/NIBP
15	90871A002	AY CBL ECG ANALOG TO OUT
18	95604A002	PRINTER MODULE 8100/9100
19	41891B001	DB9 COVER PLATE
21	42225B001	SUPPORT FRONT PLASTIC
22	42227B001	RICHCO WIRE CLIP
25	40284B001	NUT 4-40 KEPS PL
26	40284B002	NUT 6-32 KEPS PL
27	42065B004	F.H.M.S. 4-40 X.375 PH PL
28	40995B001	P.H.M.S. 4-40X.312 SEMS
29	40995B006	P.H.M.S. 4-40X.38 SEMS
33	40496B001	P.H.M.S. 6-32X.375 SEMS
35	40876B001	P.H.M.S. 8-32X.25 PL SEMS
36	40873B004	P.H.M.S. 8-32X.750 PL PH
38	42175B001	STANDOFF .632X.625 .25HEX
40	83278B001	BATTERY 8100
44	46220B001	LBL SERIAL # 8100
45	42220B001	LBLS LASER 5167 SHEET
46	40909B002	SPCR HEX 6-32X.625 NY M/F
47	40496B006	P.H.M.S. 6-32X..43 SEMS
48	42132B001	ACCESS DOOR O2 SENSOR
50	42014B001	FITNG, QUICK CON. HH NIBP
51	40284B005	NUT 10-32 KEPS PL
52	83375B001	COVER CAN CONNECTOR 8100
53	40995B005	P.H.M.S. 4-40X.25 SEMS
57	40067B003	CABLE TIE 8" LG NYLON
60	40873B001	P.H.M.S. 8-32X.375 PL PH

NIBP Pump Assembly

94252A001 AY 8100 NIBP PUMP

Item #	CSI Part #	Description
01	95576A003	AY PUMP 8100 W/ WIRES
03	95596A002	AY OKEN VALVE W/CRIMPS
05	95595A001	AY VP NIBP MANIFOLD
08	87151B006	HOUS SOCKET .098 LOCKING
10	42104B001	BRACKET OEM NIBP OS VALVE
11	42111B001	SCREW M2-.4x3 PH BINDER
13	40067B002	CABLE TIE 5.5"LG NYLON
15	40132B001	TAPE MICROFOAM ADH-BACKED
18	40296B001	TUBING SILC BLU .040x.140
19	40296B002	TUBING SILC BLU .125X.250
21	41579B003	CHECK VALVE
24	41585B003	TUBE CONECTOR,3/32 X 1/8
25	41700B001	TUBING POLYU .094IDX.187O
26	42069B001	TUBING 1/4x1/8 POLYU COIL
28	42081B002	ORIFICE RESTRICTOR .125
30	80111B001	FERRITE BEAD EMI SHIELD
32	40041B009	TUBING SHRINK .375 CLR
33	41700B003	TUBE POLYU .125x.250 70DU

Printer Module

95604A002 PRINTER MODULE 8100/9100

Item #	CSI Part #	Description
01	83279B001	PRINTER DOOR 8100/9100
02	83280B001	PRINTER HOUSING 8100/9100
03	42158B001	UPPER SHIELD PRINTER
04	84005B001	PRINTER SEIKO
05	42159B001	LOWER SHIELD PRINTER
06	91341A002	AY PCB 8100 PRINTER
07	40995B005	P.H.M.S. 4-40X.25 SEMS
08	42171B001	PRINTER MOUNT

Display Assembly

95605A003 AY DISPLAY 10.4 NEC

Item #	CSI Part #	Description
01	45119B002	DISPLAY BEZEL FRNT POET+
02	45120B001	DISPLAY BEZEL REAR
03	83342B002	DISPLAY GASKET
05	42166B001	DISPLAY MNT UPPER
06	42167B001	DISPLAY MNT LOWER
07	83313B002	PLATE FERRITE MOUNT 10.4
09	81511B001	LCD ACTIVE NEC
10	83265B002	BACKLIGHT INVERTER
12	90859A002	AY CBL MAIN BRD INVRTR 2
14	90879A001	AY CBL ACTIVE LCD TO MAIN
15	95643A002	AY CBL DISPLAY GROUND
16	42127B001	WINDOW FILTER 10.4
18	42006B001	SPACER .093ID X .188OD X
20	40008B006	NUT HEX 10-32 PL
22	42183B001	H.H.M.S. #10-32 X .625
24	40496B001	P.H.M.S. 6-32X.375 SEMS
25	40995B003	P.H.M.S. 4-40X.500 SEMS
26	42338B001	PHMS 2-56 X.312 NY PATCH
27	40995B001	P.H.M.S. 4-40X.312 SEMS
28	40294B002	HOLDER TIE WRAP ADH-BK LG
29	42182B001	WASHER NYLON #2
33	83148B001	FERRITE BD 200OHMS @ 100
36	40067B001	CABLE TIE 4.0”LG NYLON
37	40067B003	CABLE TIE 8” LG NYLON
40	83338B002	DISPLAY FILM
41	40132B001	TAPE MICROFOAM ADH-BACKED

Power Module Assembly

95612A001 AY POWER MODULE

Item #	CSI Part #	Description
01	91352A001	AY PCB BATTERY CONTACT
02	80232C001	PWR SPLY CONFORMAL COATNG
03	83276B001	BULKHEAD BATT COMPARTMENT
06	42148B001	CHASSIS REAR
07	83275B001	BATTERY CAGE
09	83274B002	DBL BATTERY LATCH
10	83273B001	BATTERY EJECTOR
11	83272B001	EXTENSN SPRING BATT EJECT
14	95619A001	AY FAN 8100 W/CONNECTORS
16	42145B001	FAN MOUNT
18	90865A001	POWER SUPPLY TO MAIN BRD
19	90875A001	THERMISTER TO MAIN BRD
24	42191B001	CLIP RICHCO
26	40995B005	P.H.M.S. 4-40X.25 SEMS
27	40995B006	P.H.M.S. 4-40X.38 SEMS
28	40995B010	P.H.M.S. 4-40 X .56 SEMS
30	40284B001	NUT 4-40 KEPS PL
32	40067B001	CABLE TIE 4.0”LG NYLON
34	42204B002	INSULATOR PWR SUPPLY
35	42208B001	BATTERY SLIDE 8100 POWER
36	40294B001	HOLDER TIE WRAP ADH-BK SM
38	83322B001	LATCH SUPPORT

Connector Assemblies

Connector Assembly—Temp/NIBP — 95618A001 CONN AY TEMP/NIBP

Item #	CSI Part #	Description
01	42133B001	CONN MNT PLATE TEMP/NIBP
03	90872A001	AY CBL TEMP CONNECTOR
04	40119B003	WASHER LOCK 3/8 INT TOOTH
05	42237B001	NUT NYLON JAM 3/8 X 32
06	42014B001	FITNG, QUICK CON. HH NIBP
07	40284B005	NUT 10-32 KEPS PL
09	42236B001	WASHER MYLAR 3/8 .015THK
10	40683B001	TAPE TRANSFER ADH 5MIL

Connector Assembly—2IBP/2Tem/NIBP — 95618A004 CONN AY 2 IBP/2 TEMP/NIBP

Item #	CSI Part #	Description
01	91351A003 IH	AY CONNECT BRD 2IBP/2TEMP
02	90872A003	AY CBL 2TEMP CONNECTOR
03	42134B001	CONN MNT PLT 2 TEMP/NIBP

Connector Assembly—2Temp — 95618A006 CONN AY 2TEMP

Item #	CSI Part #	Description
01	91351A005	AY CONNECT BRD 2TEMP
02	90872A003	AY CBL 2TEMP CONNECTOR

Tubing Assemblies

Tubing Assembly—O_2 95632A001 AY 8100 TUBING SET (W/O2)

Item #	CSI Part #	Description
	46238B001	LABEL SET 8100 PNEU
	95625A001	AY 8100 PAT INPUT TUBING
	95626A001	AY 8100 ABSORBER TUBING
	95627A001	AY 8100 PRESSURE TUBING
	95628A001	AY 8100 BLEED/CHECK TUBNG
	95629A001	AY 8100 O2->VALVE TUBING
	95630A001	AY 8100 VLV2->PUMP TUBING
	95631A001	AY 8100 VLV3->VLV2 TUBING
	95633A001	AY 8100 PUMP EXHAUST

Tubing Assembly—CO_2 95632A002 AY 8100 TUBE SET (NO O2)

Item #	CSI Part #	Description
	46238B001	LABEL SET 8100 PNEU
	95625A001	AY 8100 PAT INPUT TUBING
	95626A001	AY 8100 ABSORBER TUBING
	95627A002	AY 8100 PRESSURE TUBING
	95628A001	AY 8100 BLEED/CHECK TUBNG
	95630A001	AY 8100 VLV2->PUMP TUBING
	95631A001	AY 8100 VLV3->VLV2 TUBING
	95633A001	AY 8100 PUMP EXHAUST

The parts list for the assemblies listed above are found on the following pages.

PAT Input Tubing 95625A001 AY 8100 PAT INPUT TUBING

Item #	CSI Part #	Description
01	41700B001	TUBING POLYU .094IDX.187O
02	42063B003	TUBE PVC 1/8 X 1/16 95 DU
03	41585B002	TUBE CONECTOR,3/32 X 1/16

Absorber Tubing 95626A001 AY 8100 ABSORBER TUBING

Item #	CSI Part #	Description
01	41700B003	TUBE POLYU .125X.250 70DU
02	40570B003	ABSORBER IBENCH
03	41585B004	TUBE CONECTOR 1/8 X 1/16
04	42227B001	RICHCO WIRE CLIP

Pressure Tubing 95627A001 AY 8100 PRESSURE TUBING

Item #	CSI Part #	Description
02	40324B004	TEE TUBING .063X.063X.093
03	41570B001	ELBOW .063ID TUBING
04	42063B003	TUBE PVC 1/8 X 1/16 95 DU
05	40296B001	TUBING SILC BLU .040X.140

Bleed/Check Tubing 95628A001 AY 8100 BLEED/CHECK TUBNG

Item #	CSI Part #	Description
01	40214B002	TYGON TUBING .02IDX.06OD
02	41700B003	TUBE POLYU .125X.250 70DU
03	40296B001	TUBING SILC BLU .040X.140
04	40324B008	T CONNECTOR, WHT NYLON
06	41571B002	L CONNECTOR, WHT NYLON
07	40318B002	VALVE CHECK FLUID VL1300
08	41840B002	ORIFICE RESTRICTOR
09	42081B004	ORIFICE RESTRICTOR .002
10	42084B001	FILTER 5 MICRON 1/16 BARB
11	41700B001	TUBING POLYU .094IDX.187O

O_2 Valve Tubing (Only with pn 95632A001) 95629A001 AY 8100 O2->VALVE TUBING

Item #	CSI Part #	Description
01	41700B003	TUBE POLYU .125X.250 70DU
02	41569B001	ELBOW .094 .063 TUBING
03	42063B003	TUBE PVC 1/8 X 1/16 95 DU

Valve3, Pump Tubing 95630A001 AY 8100 VLV2->PUMP TUBING

Item #	CSI Part #	Description
01	40296B002	TUBING SILC BLU .125X.250

Valve3, Valve2 Tubing 95631A001 IHAY 8100 TUBING SET (W/02)

Item #	CSI Part #	Description
01	41700B003	TUBE POLYU .125X.250 70DU
02	41571B002	L CONNECTOR, WHT NYLON
03	41700B001	TUBING POLYU .094IDX.187O

Pump Exhaust 95633A001 AY 8100 PUMP EXHAUST

Item #	CSI Part #	Description
01	41585B003	TUBE CONECTOR,3/32 X 1/8
02	40296B002	TUBING SILC BLU .125X.250
03	40296B001	TUBING SILC BLU .040X.140
04	95599A002	AY HYDROPHOBIC DISK (CO2)